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The Grand Fir/Mountain Maple Habitat Type in Central Idaho: Succession and Management

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RESEARCH SUMMARY

A succession classification system for the grand fir/ mountain maple habitat type is presented. It is based on reconnaissance sampling of 164 stands: 21 old-growth sites, 19 pairs of old-growth versus disturbance sites, and 105 additional disturbed sites. A total of 15 potential tree layer types, 34 shrub layer types, and 55 herbaceous layer types are categorized by a hierarchical taxonomic classification. Diagnostic keys based on indicator species are provided for field identification of the layer types.

Implications for natural resource management are provided based on field data and observations. These implications include: potential for pocket gopher damage and success of tree plantations by site preparation treat- ments, initial growth rates of tree seedlings and yield capability of mature trees, microsite needs of natural tree seedlings, big-game and livestock forage preferences of shrub and herb layer types, and responses of major shrub and herb layer species to various disturbances. Species composition data for each of the tree, shrub, and herb layer types that were sampled are displayed in appendices.

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INTRODUCTION

Use of habitat type classifications over much of the West has increased professional awareness of vegetation and its variability. Managers of natural resources now recognize the need to foresee the changes in vegetation that may result from management activities. But many factors influence vegetal change, and in order to understand and communicate change, one must consider the often bewildering integral of cause and effect, and random, cyclic, and temporal relationships that are manifest in succession dynamics. A logical first step is to reduce the complexity of seral vegetation to a manageable number of units in the form of a classification.

Habitat type classifications focus on the environmental (site) differences affecting vegetation. They provide a logical framework for studying succession and occasionally infer successional relationships but offer no classification of seral communities. As one approach to meeting this need, we present herein a classification of seral vegetation designed for general field use. In so doing we have attempted to exploit the fact that natural classification, in contrast to technical ones designed for a specific use, have broader application and often provide greater prediction capability. The widely accepted habitat type system of classification is an outstanding example of a natural classification, and as its originators, R. and J. Daubenmire (1968), have pointed out "...that system may be considered the closest to a natural one that allows the most predictions about a unit from a mere knowledge of its position in the system." We developed the following classification with these criteria in mind so that the relative position of a classified unit in the system can help predict the successional status of that unit. In doing this we found that some types of seral vegetation are related to a specific disturbance; other types develop mainly through uninterrupted succession. These cause and effect relationships are presented in the sections dealing with classification as well as those dealing with management implications.

Throughout this text the reader must remember that vegetation is influenced by two independent variables: time and environment. Environment, as it affects vegetation, can be delineated by habitat types or potential climax communities (Daubenmire 1952) that are relatively stable barring disturbance. In a similar manner time, as it relates to succession, can be delineated by community types or seral stages that can be obliterated, slightly altered, or even advanced through various disturbances. Habitat type classifications have proven useful in much of the West (Layser 1974) and by focusing on climax potential, enable investigators to hold time constant while grouping plant communities that have similar environments. Conversely, environment can be held relatively constant by using habitat types while focusing on seral vegetation over time.

This report explores the changes in vegetation and related resource values occurring over time in one forest environment, the *Abies grandis/Acer glabrum* habitat type (ABGR/ACGL h.t.) (Steele and others 1981). The classification approach used here accommodates the individual nature of specific sites in terms of existing and potential species composition. It also accommodates the land managers' need for site-specific guidelines for intensive management purposes. In this regard management implications for many species can be derived from each species' reaction to a particular disturbance and its successional strategy. This report can be applied to specific sites by using the successional characteristics presented for each major species that occurs or may occur on your particular site. Throughout this report users should focus on the relative nature of data presented rather than absolute values, because relative values such as shade tolerance and successional amplitude are more easily applied than numerical values. Because this report was developed through a series of approximations, it is subject to further refinement. We welcome suggestions and comments.

This report uses a classification system (Steele 1984) that recognizes the somewhat independent nature of succession between the tree, shrub, and herbaceous layers (often due to layer-specific disturbances such as selective tree harvesting or grazing). It treats these three successions with separate

classifications. It recognizes the high potential diversity of early and mid-seral vegetation and the relative forage values to livestock and big game. It also indicates some interrelationships of site treatment, planted tree survival, competing vegetation, and pocket gopher populations. Perhaps most important, it provides a common framework for communication among various disciplines.

Objectives

The objectives of this report are:

1. To develop a classification of seral plant community types in the ABGR/ACGL h.t. based on indicator species and vegetal structure.
2. To identify successional relationships of plant community types and relate these communities to the management treatments that gave rise to them.
3. To present species composition and canopy coverage information for each shrub layer and herbaceous layer sampled and the relative value of these layers as forage for big game and livestock.
4. To describe suitable conditions for natural and artificial establishment of tree seedlings and early growth characteristics of trees in relation to site treatment, microsite conditions, and competing vegetation.
5. To determine the number of years required for each tree species to reach breast height (4.5 feet, 1.4 m) in the ABGR/ACGL h.t. when competition is minimized.
6. To provide a basis for developing preliminary management implications by seral community type.

Methods

This report is the third of a series on succession and management in forest habitat types. The methods used herein are identical to those used previously, and method details are available in the earliest final report (Steele and Geier-Hayes 1987). In general, sampling methods were similar to those used in the central Idaho habitat type study (Steele and others 1981). Circular plots (375 m^2 in size) were subjectively located so as to represent the range of site conditions and vegetal diversity characteristic of the habitat type. Recorded observations included age of last disturbance, plant coverage by species, percent survival and age to 4.5 feet (1.4 m) of planted tree seedlings, occurrence of pocket gopher mounds and snow damage to tree seedlings, methods of logging, slash disposal, site preparation, and thickness of duff layer. The plant coverage data were used to develop a succession classification (Steele 1984) and were later assembled in synthesis tables (Mueller-Dombois and Ellenberg 1974) to verify the early seral to climax arrangement of stands as indicated by the classification.

THE ABGR/ACGL HABITAT TYPE

Distribution

The ABGR/ACGL h.t. occurs mainly in west central Idaho (figs. 1, 2) but extends into northeastern Oregon (Johnson and Simon 1987). In Idaho, its southern and eastern limits nearly coincide with the geographic limits of grand fir, beyond which Douglas-fir/mountain maple and subalpine fir/mountain maple habitat types occupy similar terrain. A variant of this habitat type extends into northern Idaho where it is called the grand fir/ninebark habitat type (Cooper and others 1991). A similar association is recognized in northeastern Oregon as ABGR/ACGL-PHMA (Johnson and Simon 1987). In central Idaho the ABGR/ACGL h.t. consists of two phases: a cool, moist (*Acer glabrum*) phase and a warmer, drier (*Physocarpus malvaceus*) phase. Although both phases are quite distinct and common, the environmental and floristic gradient between the two is strongly intermediate.

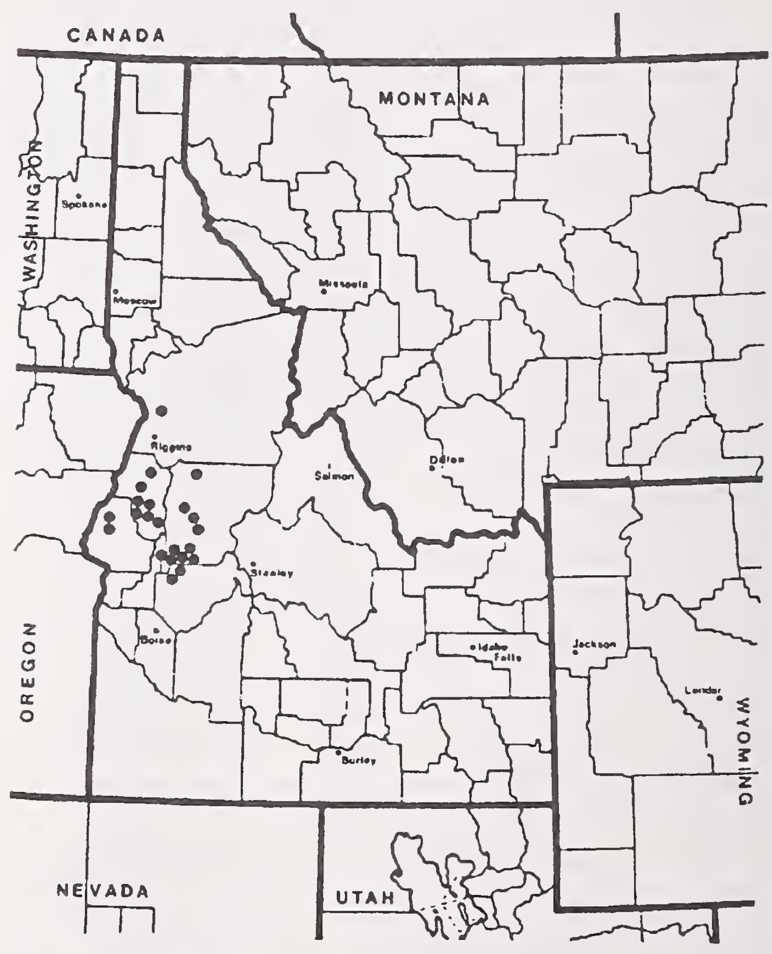


Figure 1—Distribution of the ABGR/ACGL h.t., ACGL phase in Idaho.

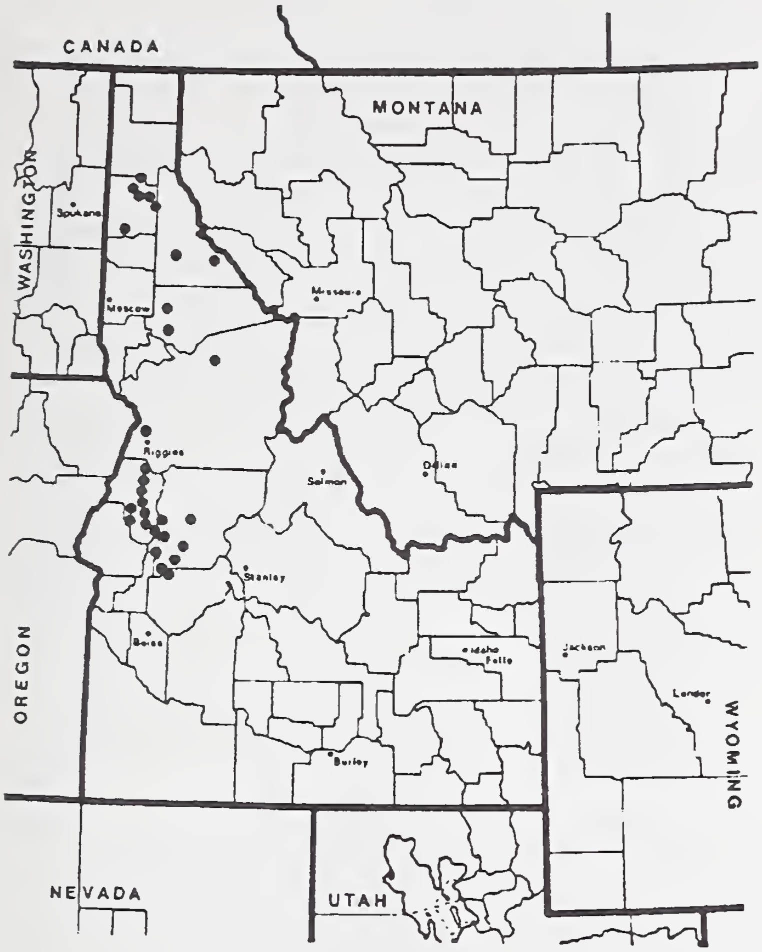


Figure 2—Distribution of the ABGR/ACGL h.t., PHMA phase in Idaho.

ACER GLABRUM (ACGL) PHASE

The ACGL phase denotes a cooler, wetter segment of the habitat type and occurs mainly in central Idaho and adjacent Oregon. Similar sites farther north encounter a stronger maritime climatic influence. Generally they support *Clintonia*, *Coptis*, or *Linnaea* and are assigned to habitat types or phases which bear those names. The ACGL phase occurs mainly on cool aspects (northeast to northwest) that may be quite steep. It ranges in elevation from 4,000 to 6,400 ft (1,220 to 1,951 m) with most sites occurring between 4,400 and 5,400 ft (1,341 to 1,646 m). Although these sites are relatively moist and generally free of frost pockets, they are often too cool for luxuriant *Physocarpus* development. The ACGL phase may be locally confined to the cold air channel of sharp ravines, yet it rarely supports stands of *Pinus contorta* that are linked to frost pockets at these elevations. In general, the ACGL phase is characteristic of environments having adequate moisture for most local conifers but with moderate temperatures best suited for *Pinus ponderosa*, *Pseudotsuga*, and *Abies grandis* (table 1).

Table 1—Elevational range and important tree species in phases of the ABGR/ACGL h.t.[1]

Important tree species	Phases[2]	
	ACGL (4,000-6,400 ft)	PHMA (4,200-6,100 ft)
Abies grandis	C	C
Abies lasiocarpa	(c)	a
Picea engelmannii	(S)	a
Pseudotsuga menziesii	S	S
Pinus ponderosa	(S)	S
Larix occidentalis	(s)	(s)
Pinus contorta	a	a
Populus tremuloides	(S)	(S)

[1]Revised from Steele and others 1981.
[2]S = seral; s = minor seral; C = major climax; c = minor climax; () = occurs in part of the phase; a = accidental occurrences.

PHYSOCARPUS MALVACEUS (PHMA) PHASE

The PHMA phase denotes the warmer, drier segment of the habitat type. Its elevational range varies from 4,200 to 6,100 ft (1,280 to 1,860 m), with most sites occurring between 4,600 and 5,200 ft (1,402 and 1,585 m). It often occurs in the same area as the ACGL phase but tends to occupy slightly drier aspects. Like the ACGL phase, it rarely occurs on southeast to southwesterly slopes. Its lowermost elevations are on steep northerly slopes where it grades into the Douglas-fir/ninebark habitat type. In fact, this phase can be visualized as a Douglas-fir/ninebark habitat type with adequate moisture for grand fir. These sites are well suited for *Pinus ponderosa* and *Pseudotsuga* but not *Pinus contorta* or *Picea* (table 1).

Description

Because the ACGL and PHMA phases share most of the same species, successional changes are quite similar. In early seral condition, the two phases may appear the same except for the prevalence of *Acer glabrum* in the ACGL phase. The *Acer* is a deeply rooted species seldom removed by disturbance, and is poorly represented in the PHMA phase. *Picea* is rare and *Alnus* is virtually absent in the PHMA phase due to the drier conditions. Toward climax *Physocarpus* becomes the prominent shrub in the PHMA phase in lieu of *Acer*; otherwise successional description of the two phases are similar.

Early seral conditions often differ according to the kind of disturbance. Following burning, *Iliamna rivularis* may appear in direct proportion to intensity of the burn being most abundant where piled slash was burned. This herbaceous perennial can quickly achieve high coverages by germinating from

accumulations of seed stored in the soil (Kramer 1984). Burning can also result in a dense layer of shrubs. *Ceanothus velutinus* and, at the lower elevations, *C. sanguineus* are the most common early seral shrubs on burned sites. These *Ceanothus* shrub layers often dominate the site within 7 to 8 years following burning and truncate the reign of early seral herbaceous species such as *Iliamna*.

Following scarification without burning, *Potentilla glandulosa*, *Carex rossii*, and *Astragalus canadensis* are the common early seral herb layer species. These species can develop high coverages as a result of numerous seeds stored in the soil. Shrub layer response to scarification is mainly *Ribes* which can dominate the site within 4 years. The *Ribes* (mainly *R. viscosissimum* and *R. lacustre*) originates from seed that has accumulated in the soil. The resulting shrub canopy is less dense than *Ceanothus* and does not exclude early seral herb layer species or shade-intolerant tree seedlings.

Early seral conditions generally support few trees (naturally established), but open stands of *Populus tremuloides* may be present. The *Populus* usually survives the burning or scarification and resprouts from a previously established root system. Plantations of young sapling *Pinus ponderosa* and *Pseudotsuga* may be present but not yet forming a tree layer. Naturally established seedlings or young saplings of *Pseudotsuga*, *Picea*, or *Abies* may be scattered through the site.

Mid-seral stages usually contain minor amounts of early seral species in a declining state. The mid-seral species, most of which established in early seral stages, are now prominent on the site. In the herb layer *Fragaria vesca* (by stolons) and *Circaea alpina*, *Apocynum androsaemifolium*, and *Pteridium aquilinum* (by rhizomes) can increase vegetatively. These species can develop high coverages in small openings or partial shade and maintain their coverage beneath mid-seral shrub or tree canopies.

The mid-seral shrub layers are characterized by species of intermediate shade tolerance such as *Salix scouleriana*, *Alnus sinuata*, *Spiraea betulifolia*, and *Rubus parviflorus*. The *Salix* establishes in clearings from windblown seed and persists beneath openings in the tree canopy. The *Alnus* occurs only on the wetter sites and through wind-dispersed seed invades areas cleared by fire or logging. It then develops thickets, which persist in mid-seral tree-dominated seres. The *Spiraea* and *Rubus* spread by rhizomes; thus these species develop high coverages beneath semiopen tree canopies.

Mid-seral tree layers may contain remnants of previous *Populus tremuloides* stands but are usually dominated by mixtures of *Pinus ponderosa* or *Pseudotsuga* with *Picea* appearing on the wetter sites. Usually *Abies grandis* is common in the understory. Planted stands of *Pinus ponderosa* are common, but no sites were found where the pine occurred naturally in pure stands.

Late seral to climax herb layers are often depauperate. Late seral stages may consist of *Aster conspicuus*, *Arnica cordifolia*, and on drier sites, *Carex geyeri* or *Calamagrostis rubescens*. The climax dominant appears to be *Thalictrum occidentale*, but it does not always occur on all sites. Where *Thalictrum* is absent, the *Aster*, *Arnica*, *Carex*, or *Calamagrostis* may occupy the climax role.

Sometimes dense stands of timber may exclude the shrub layer. In these cases, climax herb layer species are needed to key the site to habitat type. Steele and others (1981) list *Adenocaulon bicolor* and *Disporum trachycarpum* as alternate indicators of ABGR/ACGL. Since 1981, *Adenocaulon* has been found beyond the dry limits of ABGR/ACGL on several occasions. For this reason we suggest using only *Disporum* as an alternate indicator and only when dense tree canopies have excluded the shrub layer.

Shade-tolerant shrubs such as *Lonicera utahensis*, *Vaccinium globulare, Physocarpus malvaceus, Sorbus scopulina*, and *Acer glabrum* are the major shrub components of late seral to climax stages. Sometimes the tree canopy becomes so dense that even these tolerant shrubs are virtually excluded, and the sparse shrub layer belies the shrub potential of these sites.

Late seral to climax tree layers are dominated by *Abies grandis* with an occasional *Pseudotsuga* or *Picea*. The tree canopy is generally multilayered with many suppressed *Abies* in the understory. These conditions were not uncommon in ABGR/ACGL until the late 1970's when attempts to convert these stands to *Pinus ponderosa* and *Pseudotsuga* were accelerated. These attempts met with limited success in some areas, and inspection of remaining climax stands reveals that often only one generation of trees has dominated the site since the last fire. Apparently the *Abies* established beneath a dense layer of shrubs instead of replacing a *Pseudotsuga* or *Picea* tree canopy.

SUCCESSIONAL FEATURES

Succession Classification

A systematic classification of seral vegetation within the ABGR/ACGL h.t. was developed as part of this study. The basic approach (Steele 1984) was to recognize the two primary factors affecting vegetal change: time and environment. Environmental variation has been categorized by the habitat type classification system (Steele and others 1981). The habitat type system uses indicator species according

to their ability to dominate or at least maintain their population at climax. The relative value of a species as an environmental indicator is inversely related to that species' relative environmental amplitude. In other words, species with the most restricted environmental distributions on a particular site are the best indicators of that specific habitat condition.

Temporal (successional) variation within habitat types can be categorized by a comparable system that uses indicator species according to their ability to dominate a seral stage. This system of classification depends on a species' relative successional amplitude (competitive ability), which is also inversely related to indicator value. In other words, the species with the least competitive ability is the best indicator of a specific successional condition. Seral indicator species in a given habitat type can be arranged along the successional gradient according to their relative successional amplitudes. Figure 3 shows this arrangement for the major tree species in ABGR/ACGL. These indicators are then combined with possible dominant tree species to provide a temporal-structural framework for classifying seral vegetation. Figure 4 shows the classification framework derived from figure 3. Shade tolerance is often assumed to be the factor that determines successional amplitude, but, as Minore (1979) suggests,

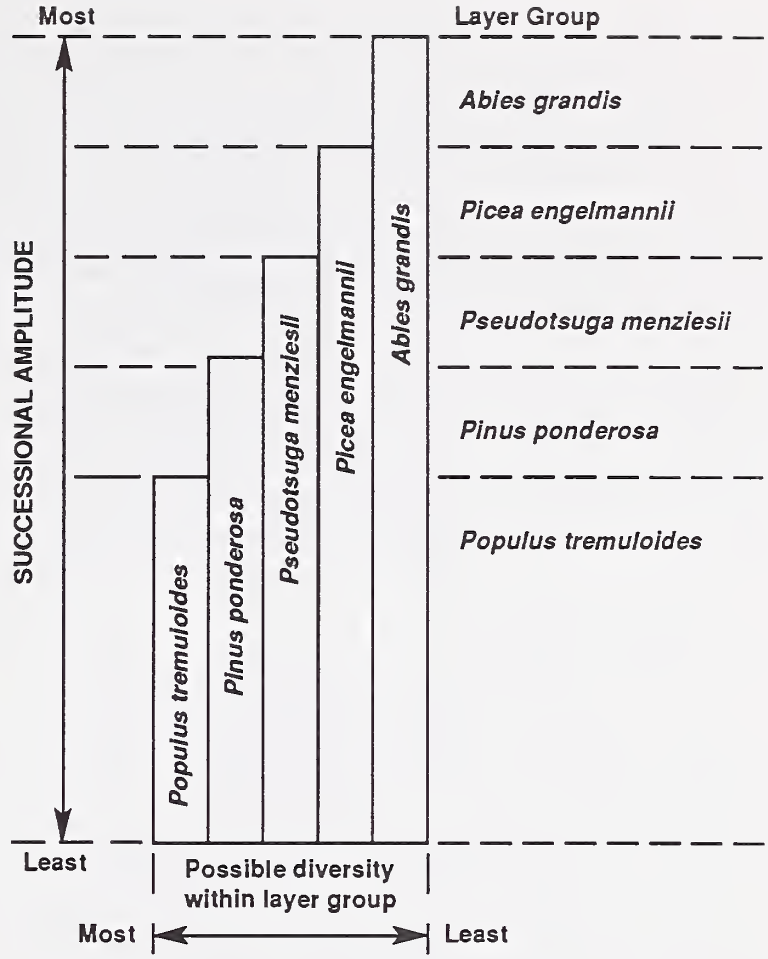


Figure 3—Relative successional amplitudes of major tree species in the ABGR/ACGL h.t.

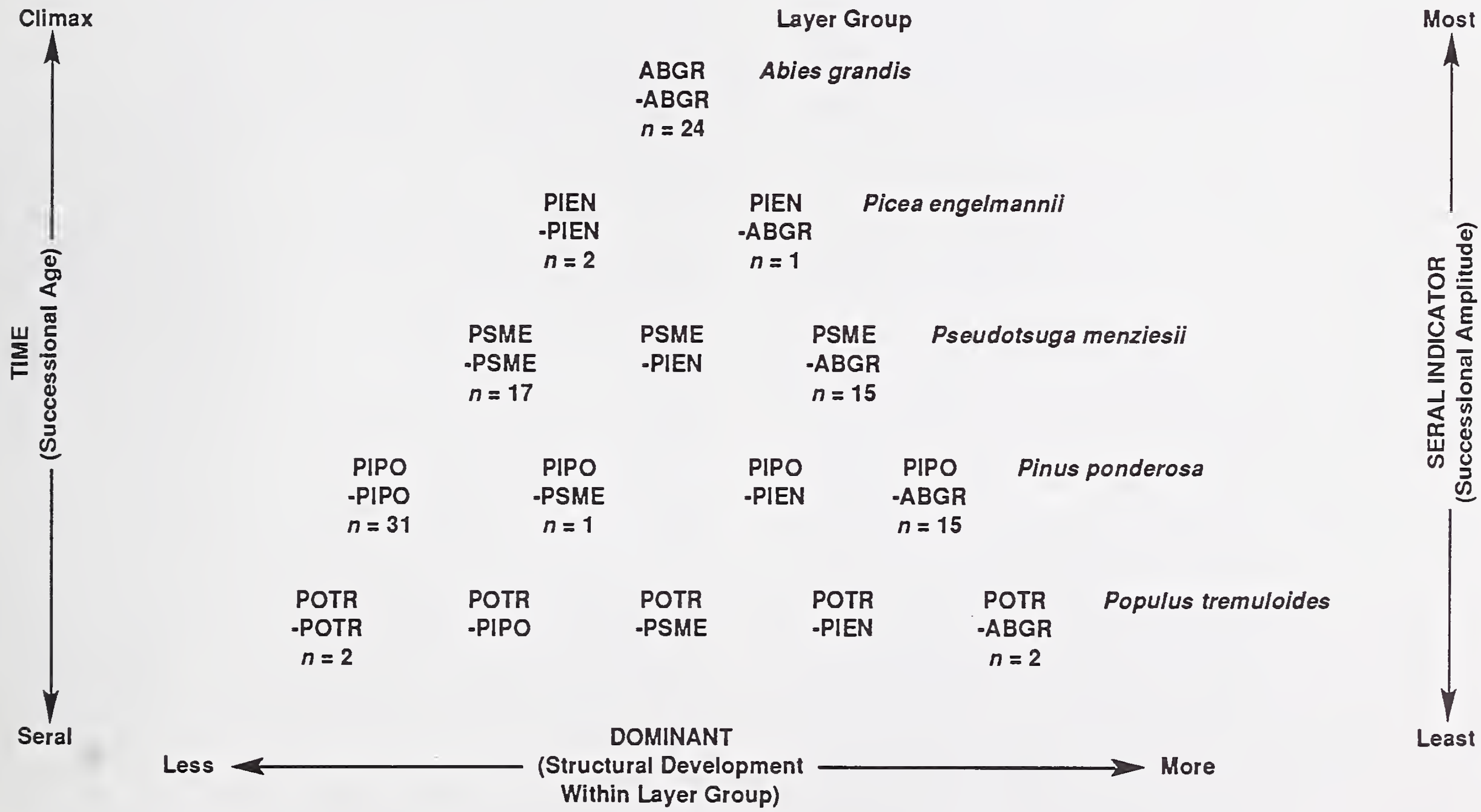


Figure 4—Succession classification diagram of the tree layer in the ABGR/ACGL h.t. (n = number of samples in each layer type).

other factors may be involved. Bazzaz (1979) addresses numerous physiological factors that affect a plant's ability to compete with its associates. Species longevity, light quality and nutrient requirements, allelopathic and disease resistance, and reproductive strategy are some of the factors involved. Fortunately, the integrated effects of all competitive factors, whether known or unknown, can be interpreted through relative successional amplitudes, which in turn provide a successional time scale for classification purposes. In contrast, if time is used on a yearly scale to classify seral communities, the relationship becomes untenable due to the randomness of successional forces such as seed crops, insects, disease, weather, and necessary combinations thereof.

The Tree Layer

Because succession in the tree, shrub, and herb layers occurs at different rates and each layer may be affected by layer-specific disturbances, each layer is classified separately. The tree layer (trees over 4.5 ft [1.4 m] tall) in ABGR/ACGL may contain five major species. Relative successional amplitudes of these species are shown in figure 3. *Populus tremuloides* is clearly less tolerant than the conifers. *Pinus ponderosa* is less shade tolerant than *Pseudotsuga* (Minore 1979), and the pine seedlings will not survive beneath the denser canopy of *Pseudotsuga*. Once the older pines in the stand have declined, another successional segment is delineated. Likewise, *Pseudotsuga* is not likely to survive beneath a canopy of *Picea*. The passing of each of these species marks a segment in the successional sequence. *Abies*, being the most shade tolerant, has the greatest successional amplitude and acts as the climax tree. Although various factors often preclude the entire replacement sequence, the relative successional amplitudes have been established for classification purposes.

Figure 3 suggests that species diversity of the tree layer is potentially greatest in the early seral stages. Here all five species could be present on the site, although usually this is not the case. In the climax stage, however, only *Abies* will be well represented with all other tree species poorly represented or absent. Diminishing diversity during secondary succession becomes more apparent in the shrub and herb layer classifications where more species occur.

Figure 4 shows the possible seral conditions in the tree layer that may converge to a common climax of *Abies*. *Populus tremuloides* forms the base of the triangle because it has the least successional amplitude. Other species are arranged in ascending order as a reflection of their progressively greater successional amplitudes. Each taxonomic unit in figure 4 is called a layer type, and each group of layer types having the same seral indicator is called a layer group. Layer groups denote the various seral stages that are possible within a given habitat type or phase. Layer types within one layer group, such as PIPO-PIPO, PIPO-PSME, PIPO-PIEN, and PIPO-ABGR in the PIPO layer group, denote the various species that may dominate in that particular seral stage. To some extent, layer types also denote structural conditions, although more than one species may be abundant in the same layer type. These conditions may result from natural establishment of tree seedlings or tree plantations. The plantations often result initially in a PIPO-PIPO layer type. Similar classifications were developed for the shrub and herb layers. If desired, taxonomy of the tree, shrub, and herb layers can be combined to characterize the entire plant community.

Delineating the vertical axis (successional time) into layer groups (fig. 4) provides an ecological basis for segmenting the succession. As succession progresses, a stand's classification status should advance from one layer group to a successionally older layer group. For instance, *Pinus ponderosa* (well represented) may dominate the tree layer (PIPO-PIPO) or may be dominated by *Pseudotsuga* (PIPO-PSME) or *Abies grandis* (PIPO-ABGR). But the presence of *Pinus ponderosa* can always be interpreted as a specific segment of succession because the potential to be replaced by *Pseudotsuga* or *Abies* always exists. *Pinus ponderosa* is unable to replace *Pseudotsuga* or *Abies* without the aid of disturbance but once established can always outcompete *Populus tremuloides*.

Figure 4 serves as a **classification diagram** (not a succession model) for seral tree layers in the ABGR/ACGL h.t. These and the other diagrams herein do not outline actual successions for a given site but rather illustrate the possibilities within the habitat type. Actual successions skip many layer types and even layer groups within their respective diagrams. A succession can be described in terms of the layer types shown, but is determined by species composition of the stand and available seed sources.

Figure 4 also serves as a basis for constructing a simple key to tree layer types for field use. This is done by starting with the earliest layer group in figure 4 and progressing along the time gradient to climax (table 2). Keys to the shrub and herb layer types are constructed the same way. These keys are intended to be used in the same manner as the habitat type keys (Pfister and others 1977; Steele and others 1981).

SIZE CLASS NOTATIONS

The basic classification approach used in the tree, shrub, and herb layers was presented in figures 3

Table 2—Key to tree layer groups and layer types, with ADP codes, in the ABGR/ACGL h.t.

		ADP codes
1. *Populus tremuloides* well represented 1[1]	POTR LAYER GROUP	014
1a. *Populus tremuloides* dominant	POTR-POTR Layer Type	014.014
1b. *Pinus ponderosa* dominant or codominant.	POTR-PIPO Layer Type	014.013
1c. *Pseudotsuga menziesii* dominant or codominant	POTR-PSME Layer Type	014.016
1d. *Picea engelmannii* dominant or codominant	POTR-PIEN Layer Type	014.007
1e. *Abies grandis* dominant or codominant.	POTR-ABGR Layer Type	014.001
1. *P. tremuloides* poorly represented	2	
2. *Pinus ponderosa* well represented	PIPO LAYER GROUP	013
2a. *Pinus ponderosa* dominant	PIPO-PIPO Layer Type	013.013
2b. *Pseudotsuga menziesii* dominant or codominant	PIPO-PSME Layer Type	013.016
2c. *Picea engelmannii* dominant or codominant	PIPO-PIEN Layer Type	013.007
2d. *Abies grandis* dominant or codominant	PIPO-ABGR Layer Type	013.001
2. *P. ponderosa* poorly represented.	3	
3. *Pseudotsuga menziesii* well represented	PSME LAYER GROUP	016
3a. *Pseudotsuga menziesii* dominant	PSME-PSME Layer Type	016.016
3b. *Picea engelmannii* dominant or codominant	PSME-PIEN Layer Type	016.007
3c. *Abies grandis* dominant or codominant.	PSME-ABGR Layer Type	016.001
3. *P. menziesii* poorly represented	4	
4. *Picea engelmannii* well represented	PIEN LAYER GROUP	007
4a. *Picea engelmannii* dominant	PIEN-PIEN Layer Type	007.007
4b. *Abies grandis* dominant or codominant	PIEN-ABGR Layer Type	007.001
4. *P. engelmannii* poorly represented	5	
5. *Abies grandis* well represented	ABGR Layer Group	001
5a. *Abies grandis* dominant	ABGR-ABGR Layer Type	001.001
5. *A. grandis* poorly represented	depauperate tree layer or not ABGR/ACGL h.t.	

[1]"Well represented" means canopy coverage ≥5 percent regardless of diameter classes of the trees involved. Trees less than 4.5 ft (1.4 m) tall should be omitted from coverage estimates. "Dominant" refers to greatest canopy coverage, "codominant" refers to nearly equal canopy coverage.

and 4 and table 2, but because the tree layer progresses through recognizable size classes of development such as sapling (0.1-4 inches, 0.25-10.2 cm d.b.h.), pole (4-12 inches, 10.2-30.5 cm), mature (12-18 inches, 30.5-45.7 cm), and old-growth (>18 inches, 45.7 cm), these additional subdivisions should be noted. These notations are best added to each tree species after the tree layer type (l.t.) is identified, such as, mature PIPO-sapling PSME l.t. For consistency, the smallest size class that is well represented should be noted for the successional indicator because it best reflects the regeneration capability of that particular species. For the dominant species, the dominant size class should be used. When the indicator species is well represented in the stand but not in any one size class or the dominant species does not have a dominant size class, the size class notations with the most coverage should be noted. For convenience, size class can be abbreviated as follows: s. – sapling; p. – pole; m. – mature; and o.g. – old-growth.

It may be difficult at first to visualize some tree layer types in their appropriate successional position. For instance, an s. ABGR – s. ABGR l.t. may not seem to be successionally older than an m. POTR – p. PSME l.t., because we normally think of time related situations on a yearly scale. On a successional scale, however, a pure stand of sapling *Abies grandis* is closer to climax than a mixed older stand of *Populus* and *Pseudotsuga* because it will not go through the earlier successional stages of the POTR, PIPO and PSME layer groups. In fact, an s. ABGR – s. ABGR l.t. may even reach climax in fewer years because no species replacement (succession) is needed whereas an m. POTR – p. PSME l.t. must first lose the *Populus* and, if *Pinus ponderosa* is well represented, must also pass through a PIPO-PSME and PSME-ABGR l.t. before reaching climax.

The five possible tree layer groups in ABGR/ACGL (fig. 4) are described below and delineate tree layer succession into relatively broad segments. Because layer groups are usually delineated by a single indicator species, their origin can be related to a somewhat consistent set of site conditions or disturbances. But progression from one layer group to another (and one layer type to another) depends on composition and structure of the individual stand and, therefore, is predictable only from field observation. The following layer group descriptions are presented in the order they appear in the key (table 2). Constancy and average cover of species within sampled layer types appear in appendix A.

POPULUS TREMULOIDES LAYER GROUP (POTR L.G.)

Populus tremuloides can establish by seed on newly exposed mineral soil that remains moist during the critical germination period. Viability of freshly fallen seed usually exceeds 90 percent but lasts only about 3 weeks (Brinkman and Roe 1975). Occasional *Populus* seedlings have established in well scarified areas, but usually the young trees originate from root sprouts following fire or logging. If large *Populus* trees are cut, the roots can produce numerous suckers, provided adequate sunlight is available. The suckers provide excellent forage for deer and elk. An occasional *P. trichocarpa* may also establish in recent clearings but rarely is a large specimen ever found. Apparently *P. trichocarpa* cannot compete successfully once the site is fully occupied and moisture demands increase.

In the ABGR/ACGL h.t., the POTR l.g. consists of five possible layer types (fig. 4). These layer types usually result from resprouting of scattered, often decadent, *Populus* following overstory removal by wildfire or logging. When *Populus* is present in the stand and no conifers establish soon after disturbance, a POTR-POTR layer type can result. In this layer type, subsequent invasion by conifers may be slow even when seed sources are nearby. Reasons for this are unclear, but Younger and others (1980) have shown that leaf litter of *P. tremuloides* can chemically inhibit seedling growth of several grasses. Possibly, conifer seedlings are also affected. Because the POTR-POTR layer type creates only light shade, it permits lush development of the shrub and herbaceous layers, which also hinder conifer establishment. Simultaneous establishment of *Pinus ponderosa*, *Pseudotsuga*, or *Picea* with the resprouting of scattered *Populus* can produce a POTR-PIPO, POTR-PSME, or POTR-PIEN layer type. All of these can progress to a PIPO, PSME, or PIEN layer group more quickly than the POTR-POTR layer type.

POTR layer types are uncommon in ABGR/ACGL but could develop on any site supporting *Populus tremuloides*. Only four stands in this layer group have been found (fig. 4). All appear to have developed following severe wildfire about 40 to 70 years ago (fig. 5). Seedlings of *Abies grandis* and occasionally *Pseudotsuga* were common in these stands. This contrasts with drier habitat types such as Douglas-fir/ninebark where conifer seedlings are scarce in POTR layer types in spite of adequate seed sources.

PINUS PONDEROSA LAYER GROUP (PIPO L.G.)

Pinus ponderosa occurs throughout most of the ABGR/ACGL h.t. but may be absent on wetter sites in the ACGL phase. Although a major seral species, *P. ponderosa* is seldom the predominant tree under natural conditions and does not readily colonize recent clearcuts. Lack of seed and unsuitable seedbeds apparently limit its establishment. Distance to seed source and infrequent seed crops are responsible for the lack of seed. Shrubs and forbs quickly dominate potential seedbeds, and the tall growing shrubs can outcompete pine seedlings. Consequently, natural establishment of *P. ponderosa* is sporadic in ABGR/ACGL. But in the PHMA phase, thoroughly scarified unburned sites beneath a partial canopy of seed-producing pine should regenerate a PIPO layer type. Similar results may occur in the ACGL phase provided the site is not moist enough to support *Alnus sinuata*. High densities of *Picea* or the presence of *Alnus*, *Ribes lacustre*, or *Actaea* are likely indicators of potential *Alnus* colonization. The *Alnus* can establish on bare soil from wind-deposited seed and may outcompete *Pinus ponderosa* seedlings. Although an occasional pine may be present on these sites, attempts to establish stands of pine, naturally or by planting, will likely fail if an *Alnus* seed source is nearby.

PIPO layer types are common in ABGR/ACGL (fig. 4), and each appears related to certain situations. PIPO-PIPO results only from plantations (fig. 6). PIPO-PSME was found only in the PHMA phase on sites transitional to the Douglas-fir/ninebark habitat type. PIPO-PIEN was not found but might occur at the moist extreme of the ACGL phase following several wildfires. PIPO-ABGR was common except at moist extremes of the ACGL phase. It occurs in unmanaged stands that experienced repeated wildfire followed by several decades without fire (fig. 7).

Figure 5—Pole POTR – pole POTR tree layer type in Mica Creek drainage southeast of Council, ID, in 1982. Tree layer appears to have established on a large landslide that occurred 70 to 80 years ago following a wildfire. *Abies grandis* in trace amounts is the only conifer on the site.

Figure 6—Sapling PIPO – sapling PIPO tree layer type west of Tamarack, ID, in 1984. Site was clearcut in 1974, logging slash bulldozer-piled and burned the following year. *Pinus ponderosa* seedlings planted spring of 1976. Repeated control of pocket gophers necessary, probably as a consequence of the vegetation response to the pile-and-burn treatment.

Figure 7—Old-growth PIPO – pole ABGR tree layer type in Johnson Creek drainage west of Council, ID, in l980. The large pines have survived several fires and likely formed an open parklike stand at one time. Lack of fire for the past 50 to 60 years has allowed a dense, pole-size stand of *Abies grandis* to develop beneath the pines.

PSEUDOTSUGA MENZIESII LAYER GROUP (PSME L.G.)

Pseudotsuga is a common seral tree throughout ABGR/ACGL. It is moderately shade tolerant and thus a logical species for establishing among the tall shrubs common to this habitat type. *Pseudotsuga* seedlings benefit from the shade of shrub canopies and can compete more successfully with tall shrubs than *Pinus ponderosa*. In fact, most natural stands of *Pseudotsuga* appear to have established beneath the shelter of trees or shrubs. Certain shrub species, however, seem to provide better tree seedling microsites than other shrub species. (See Natural Tree Establishment under Shrub Layer section for further discussion.)

PSME layer types occur throughout ABGR/ACGL. Generally such layer types result from either successional advance or selective logging where the pine has been removed. The PSME-PSME layer type occurs mainly in the PHMA phase. It has resulted mostly from natural regeneration following stand-destroying wildfire or clearcutting with little site treatment. In most situations, these sites are poorly stocked. The PSME-ABGR layer type occurs mainly in the ACGL phase on sites that have had a long fire-free period. Many of these stands have experienced partial cutting. *Pinus ponderosa* may have been eliminated by either logging or succession, or it may have never become established. The PSME-PIEN layer type was not found but may occur at the moist extreme of the ACGL phase.

PICEA ENGELMANNII LAYER GROUP (PIEN L.G.)

Picea engelmannii is relatively shade tolerant and is considered a late seral to near climax species in ABGR/ACGL. It occurs mostly at the moist extreme of the ACGL phase and shows its best development where *Alnus*, *Ribes lacustre*, or *Actaea* are found. The litter and duff from *Picea* is thought to inhibit germination and growth of certain conifers such as *Picea* and *Pseudotsuga*. One study (Daniel and Schmidt 1971) suggests that fungi living in the duff inhibit the seedlings while another study (Taylor and Shaw 1982) suggests that chemicals from the duff are the inhibitory agent. Whatever the cause, it is clear that mineral soil is a more favorable seedbed for *Picea*. The seedbed (preferably shaded) can be enhanced further by a thin layer of fresh litter or development of a moss mat (Geier-Hayes 1987).

Two PIEN layer types are possible in ABGR/ACGL, and both were found (fig. 4). Neither is

common, and both occur only in the ACGL phase. The PIEN-PIEN layer type was the result of partial cutting to favor *Picea* 11 to 15 years ago. The PIEN-ABGR layer type resulted from natural regeneration in a 20-year-old clearcut. Beneath both layer types, a dense layer of *Alnus* had developed in response to the logging disturbance. Tree regeneration is often sparse beneath the *Alnus* and is limited to *Picea* and *Abies grandis*.

ABIES GRANDIS LAYER GROUP (ABGR L.G.)

Abies grandis is the most shade-tolerant tree species in ABGR/ACGL and thus acts as the climax species. It regenerates easily following most forms of site treatment and is likely to be the most successful tree species on cutover sites having no treatment. The heartrot, *Echinodontium tinctorium*, may occur in *A. grandis* but is not always present throughout the ABGR/ACGL h.t. On drier sites, and especially, in the PHMA phase, the heartrot may be absent. At the cool, moist extremes of the habitat type where *Picea* is prevalent, the heartrot may cause serious defect in *A. grandis*.

The ABGR layer group, being climax, consists of only one layer type (fig. 4). This layer type has resulted from several conditions, the most common being selective cutting that has removed the *Pinus ponderosa*, *Pseudotsuga*, or *Picea*. Overstory removal also produces the climax tree layer because most of the understory is usually *A. grandis*. Historically, the ABGR-ABGR layer type resulted from succession of PIPO, PSME, or PIEN layer types, but low-intensity surface fires often reversed this replacement process. Stand-destroying wildfires, however, can facilitate development of the ABGR-ABGR layer type by creating dense shrubfields beneath which *A. grandis* is best suited for establishing a new stand (fig. 8). Regardless of its origin, the ABGR-ABGR layer type probably has the greatest hazard potential for catastrophic fire, spruce budworm, and wood decay of any tree layer type in ABGR/ACGL. Generally, the seral tree species are more desirable in terms of maintaining a healthy, productive, and more fire-resistant stand.

MANAGEMENT IMPLICATIONS

The following implications for management of the tree layer were derived from data and repeated field observations taken during this study and the habitat type study (Steele and others 1981). Users of the following information should keep in mind the often small sample size of the data set and the minimal amount of field testing and user response. Yet trends reflected by these data appear logical and

Figure 8—Dense pole ABGR – mature ABGR tree layer type in Fall Creek drainage southeast of Council, ID, in 1979. This climax tree layer apparently established beneath a shrub layer following the last fire. No evidence of succession from a seral tree layer. Depauperate undergrowth belies the potential for shrub and herb layer development from buried seed.

seem adequate to support interpretations on a relative basis.

Pocket Gophers—It has long been known that pocket gophers (*Thomomys talpoides*) can damage pine plantations (Moore 1943; Dingle 1956). Reasons for this damage have been studied at length. In summarizing gopher-related studies, Teipner and others (1983) suggest that gopher damage to young pines may be related to amount and composition of associated plant species as well as gopher density. Our studies indicate that species composition can vary with type of site preparation prior to tree planting which, in turn, may influence gopher populations. Therefore, pocket gopher mounds as an indication of gopher activity (Richens 1965) were tallied in our sample plots and then summarized by site treatment.

Pocket gophers are often present on disturbed sites in ABGR/ACGL, but are most numerous in cutover areas that have been thoroughly scarified but not burned (figs. 9, 10). Gophers were also numerous on scarified areas in several other habitat types

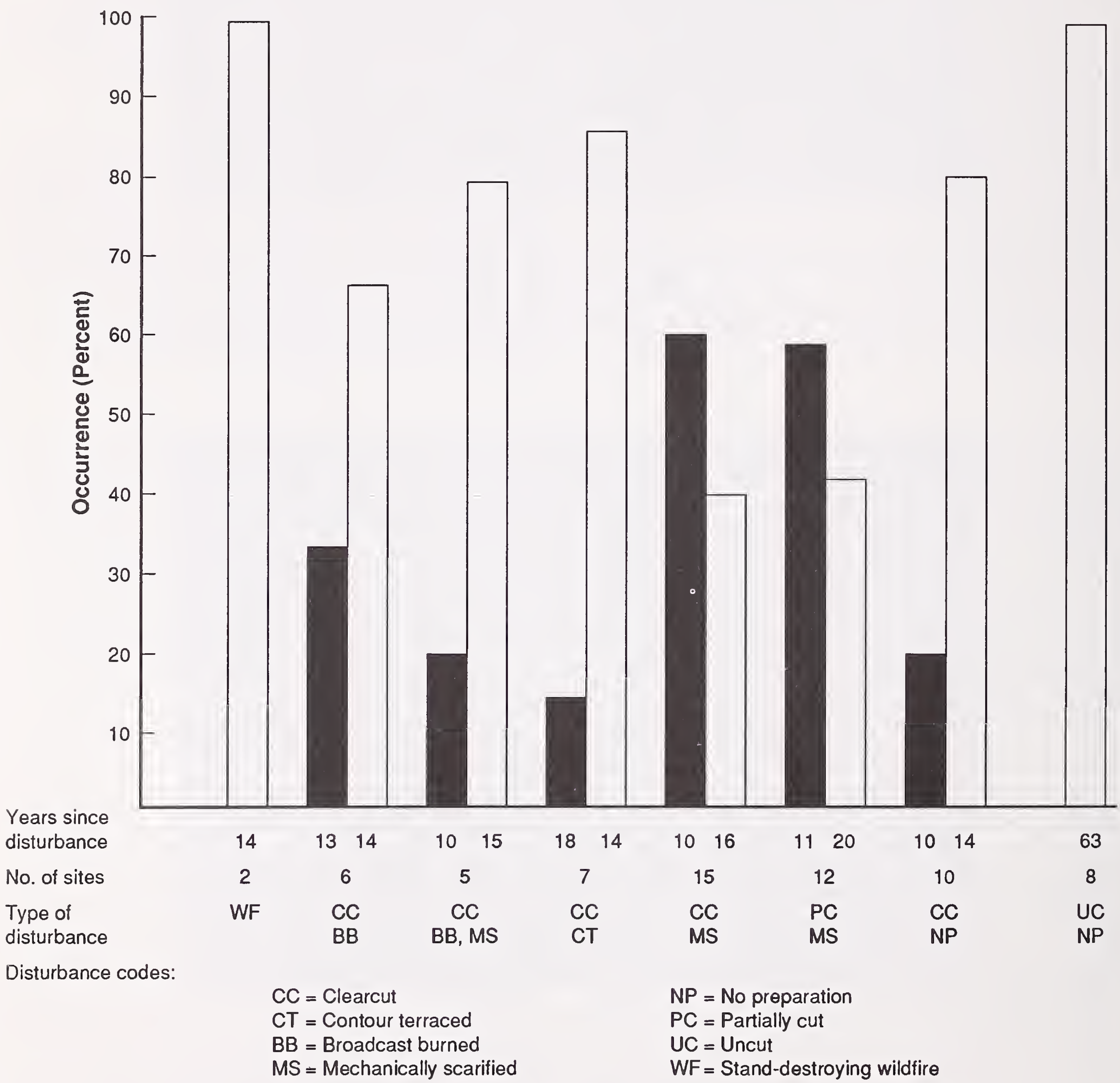
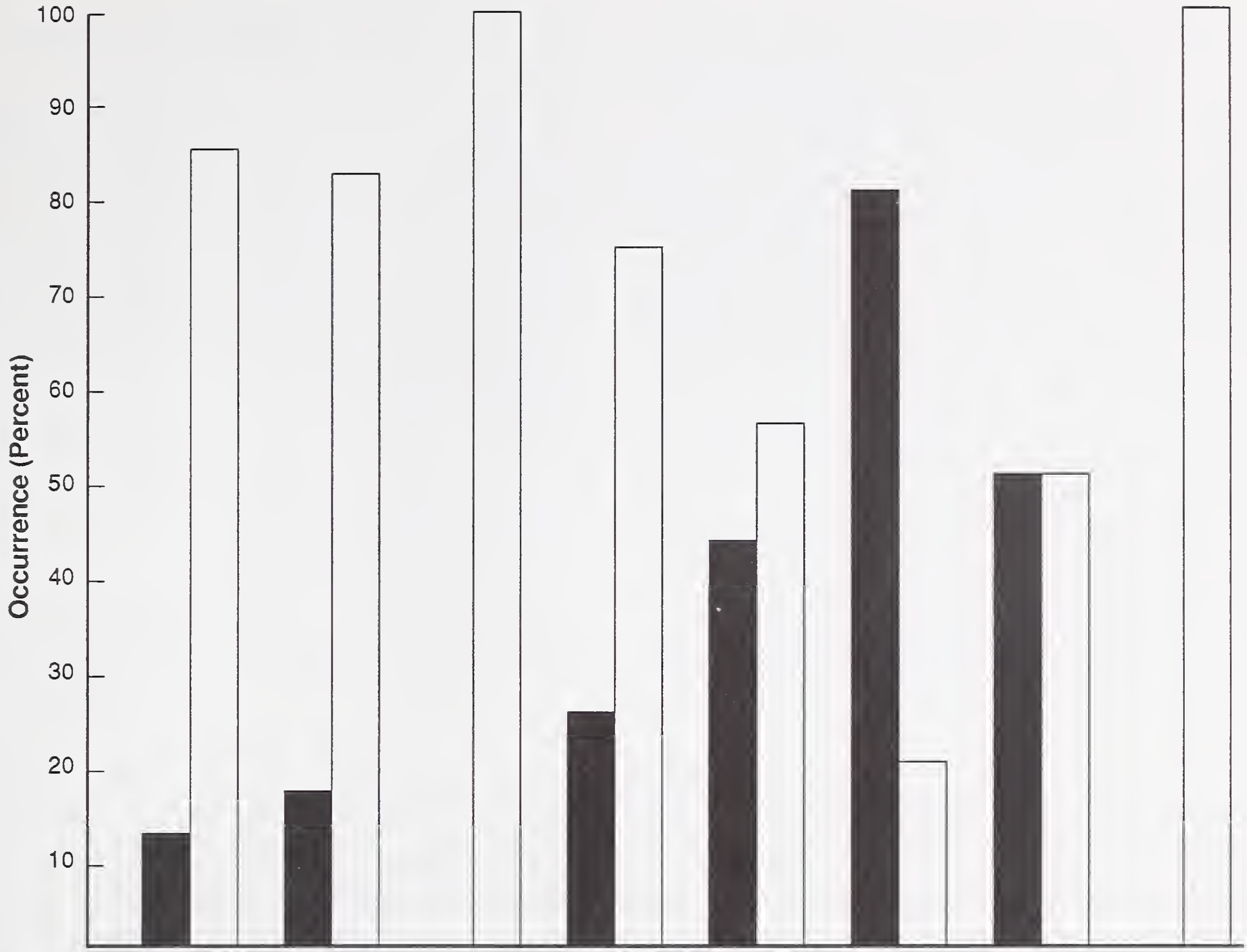


Figure 9—Occurrence of sites with pocket gopher mounds (solid bars) and sites without mounds (hollow bars) following various disturbances in the ABGR/ACGL h.t., ACGL phase.



Years since disturbance	54 44	20 12	13	17 29	11 9	9 9	16 15	61
No. of sites	7	6	8	8	16	5	4	6
Type of disturbance	WF	CC BB	CC BB, MS	CC CT	CC MS	PC MS	CC NP	UC NP

Disturbance codes:

CC = Clearcut
CT = Contour terraced
BB = Broadcast burned
MS = Mechanically scarified

NP = No preparation
PC = Partially cut
UC = Uncut
WF = Stand-destroying wildfire

Figure 10—Occurrence of sites with pocket gopher mounds (solid bars) and sites without mounds (hollow bars) following various disturbances in the ABGR/ACGL h.t., PHMA phase.

(Steele and Geier-Hayes 1989, 1987, 1986). The gophers respond to the vegetation resulting from the site treatment. Machine scarification or heavy livestock use is most apt to generate early seral herbaceous layers that apparently result in high gopher populations. In contrast, broadcast burning without scarification can result in a depauperate herb layer by generating a dense shrub layer. Burning also results more often in mid- to late-seral herbaceous layers, which apparently have less appeal to gophers. (See Herb Layer section for further discussion.)

Pocket gophers are usually absent in unlogged stands that have had little or no disturbance (figs. 9, 10). Clearcutting of these stands can result in low gopher populations provided the clearcut does not border areas having high gopher populations. But stands that have had partial cutting and some soil disturbance may already have a gopher population. Clearcutting these stands can result in severe gopher problems, and scarifying the site may exacerbate the problem.

Planted Tree Establishment—Planted sites were identified from plantation signs and obvious rows of even-aged trees. The percentage of tree survival was estimated for each site preparation technique. Site preparation included no preparation, hand scalps, scarification with and without burning, and contour terraces. Hand scalping was grouped with no preparation because it usually did not reduce long-term competition and because it could not always be recognized in older plantations. Scarification treatments usually resulted from stripping, pile and burn operations, or extensive machinery traffic during the logging operation.

Planted *Pinus ponderosa* seedlings showed the highest survival on sites that had been scarified (tables 3, 4). The scarification usually resulted from a bulldozer-pile and burn operation, which often removes the shallow root crowns of competing species. This particular site treatment creates the least competition for tree seedlings but also results in the greatest soil displacement, the largest gopher populations, and the least wildlife forage. Bulldozer piling should be necessary only where the residual shrub layer presents severe competition over the 10 years following reforestation.

Pinus ponderosa survival was slightly more than 50 percent on contour terraces (tables 3, 4) which is considerably lower than in some other habitat types (Steele and Geier-Hayes 1987, 1989). Many of these sites had experienced a stand-destroying wildfire several decades before the terracing operation and as a result supported dense shrubfields. Following the terracing, the tall growing shrubs rapidly encroached over the terraces and shaded the pine seedlings, causing a gradual decline in survival. Reduced growth rates due to snow damage also contributed to the young pines' demise. It appears that contour terraces are inappropriate and unnecessary in ABGR/ACGL in spite of the outstanding successes on more severe habitat types.

Pine seedling survival following broadcast burning averaged 38 percent in the ACGL phase and 68 percent in the PHMA phase (tables 3, 4). Although only meaningful on a relative scale, the lower survival in

Table 3—Success of tree plantations by site treatment in the ABGR/ACGL h.t., ACGL phase

Tree species	Site treatment[1]: None, includes hand scalps	Broadcast burning	Scarified unburned, includes stripping	Contour terraces, includes ditching
	Survival of planting, percent (average age)[2]			
Pinus ponderosa	14(14) *n* = 2	38(14) *n* = 7	58(14) *n* = 8	51(14) *n* = 6
Pseudotsuga menziesii	—	34(8) *n* = 5	1(13) *n* = 1	28(14) *n* = 2
	Average age to breast height, years			
Planted[3]				
Pinus ponderosa	8 *n* = 2	8 *n* = 7	8 *n* = 10	7 *n* = 8
Pseudotsuga menziesii	—	10 *n* = 2	10 *n* = 4	12 *n* = 1
Natural				
Pinus ponderosa	—	—	11 *n* = 1	10 *n* = 1
Pseudotsuga menziesii	14 *n* = 3	10 *n* = 2	11 *n* = 1	8 *n* = 1
Picea engelmannii	—	—	16 *n* = 1	—
Abies grandis	—	—	16 *n* = 1	16 *n* = 3

[1]*n* = number of sample sites.
[2]Plantings less than 4 years old were omitted; complete plantation failures and multispecies plantings could not be sampled for survival.
[3]Nursery years are not included.

Table 4—Success of tree plantations by site treatment in the ABGR/ACGL h.t., PHMA phase

Tree species	Site treatment[1] None, includes hand scalps	Broadcast burning	Scarified unburned, includes stripping	Contour terraces, includes ditching
	Survival of planting, percent (average age)[2]			
Pinus ponderosa	—	68(14) *n* = 6	70(12) *n* = 9	54(17) *n* = 7
Pseudotsuga menziesii	—	—	60(9) *n* = 3	—
	Average age to breast height, years			
Planted[3]				
Pinus ponderosa	—	7 *n* = 6	8 *n* = 7	8 *n* = 8
Pseudotsuga menziesii		—	12 *n* = 1	—
Natural				
Larix occidentalis		6 *n* = 2	6 *n* = 3	—
Pinus ponderosa		—	—	—
Pseudotsuga menziesii		9 *n* = 2	— —	—
Abies grandis	—	15 *n* = 1	—	—

[1]*n* = number of sample sites.
[2]Plantings less than 4 years old were omitted; complete plantation failures and multispecies plantings could not be sampled for survival.
[3]Nursery years are not included.

the ACGL phase reflects the greater shrub competition on these sites. Intense burning may destroy the shrub canopy but rarely kills the roots of existing shrubs and often causes other shrubs, like *Ceanothus*, to germinate from buried seed. Usually the residual shrubs resprout with renewed vigor and develop canopies more dense than those that existed prior to logging. During the first decade following burning, these shrubs can rapidly overtop pine seedlings. In ABGR/ACGL, broadcast burning as a site treatment for pine is appropriate only where tall-growing, residual shrubs are sparse. Where shrubs are both tall and dense, planting *Pseudotsuga* following broadcast burning is more appropriate.

Establishing *Pinus ponderosa* plantations on ABGR/ACGL sites is often difficult, and the probability of success may be low regardless of the site treatment used. The steep slopes limit machine use, and the intense shrub competition and snow damage potential reduce the chances for survival and growth of young pines. In natural stands, the pine rarely dominates the tree layer in spite of the high growth potential for the species. Apparently, natural forces are limiting pine establishment, and it may be more economical to manage for *Pseudotsuga* or *Picea* on these sites.

The survival percentages in tables 3 and 4 may differ considerably from Ranger District records for two reasons. First, these data reflect planting attempts over many years, and many early planting failures were due to factors other than site treatment and habitat type. Second, the data reflect seedling success over the past 10 to 30 years, whereas District records are generally maintained for only a few years after planting and do not reflect the long-term effects of site and competition. Our figures do not necessarily indicate the highest possible survival rates because occasionally high survival rates have been achieved in several treatment categories. Our survival rates are best interpreted as a relative probability of success between treatments rather than expected percentage of survival.

Age to Breast Height—The years required for a tree to reach breast height (4.5 ft, 1.4 m) can be a critical factor in estimating growth and yield

parameters of forest stands as well as seedling success against competing vegetation. Normally an estimated constant is used for a given species regardless of site. Yet for some species, sample data have shown considerable variability in breast height ages between habitat types and even between site treatments within a habitat type or phase. In ABGR/ACGL, breast height age for planted *Pinus ponderosa* is about 7 to 8 years regardless of site treatment (tables 3, 4). Planted *Pseudotsuga* appear to reach breast height in about 10 to 12 years. Natural regeneration may take a few years longer following some site treatments, but the data are too sparse for an accurate comparison.

Snow Damage to Pine Plantations—Snowpack damage to young conifers was noted in many communities of the ABGR/ACGL h.t. Some minor damage was noted on *Larix* and *Pseudotsuga*, but most of the damage occurs on planted *Pinus ponderosa*. Extent of snow damage within plantations can vary from scattered individual trees at lower elevations to virtually all trees at the upper elevations. The damage varies from stripped lateral branches and bent terminals to 90 degree bends in the main stem and to entire saplings leaning downhill at various angles. Although the young pines can recover from much of this damage as described by Oliver (1970), they are often damaged in subsequent years making full recovery unlikely. These saplings are vulnerable to damage from the time they lose flexibility (about 4.5 ft [1.4 m] in height) until they reach about 4 inches (10.2 cm) d.b.h. In ABGR/ACGL this window of vulnerability lasts about 13 years but can last longer if the pines are shaded by tall shrubs or trees. Long-term snow records indicate that snow damage may occur about every 4 years (Megahan and Steele 1987). As a result, the trees often receive repeated damage causing accumulated deformities. Unless severely damaged, or broken, the trees continue to live but growth rates are reduced (Rehfeldt 1987; Williams 1966), compression wood forms on the downhill side (Panshin and others 1964), and the trees remain vulnerable to shrub competition for longer periods. Occasionally, at the highest elevations, the bent, stunted trees are killed by the brown-felt blight (*Neopeckia coulteri*) during years of deep snow and prolonged snowmelt. But usually these highly productive sites remain occupied by stunted deformed trees having low productivity potential.

Recognizing possible snow damage hazards is important where pine plantations are a management objective. A simple technique for predicting snow damage hazards to pine plantations is now available (Megahan and Steele 1988). This approach uses easily measured site characteristics such as slope, aspect, and elevation, but correctly predicts high-hazard sites only about 74 percent of the time. On questionable sites, further consideration may be needed. Sometimes simple field observations can reveal high snow damage potential. The larger, less flexible stems of tall plants such as *Populus* or *Prunus* may show deformities from past snow damage. Highly flexible plants such as *Ceanothus*, *Alnus*, *Acer*, or small *Populus* may show considerable downhill "sweep" to their growth form, and in some timber stands the bases of trees may be curved downhill showing a "pistol butt" growth form. All of these characteristics are possible indicators of high snow hazards and should be considered when assessing snow damage potential in ABGR/ACGL.

The decision to plant *Pinus ponderosa* on a particular site is often based on the presence of large, high-value pines prior to logging. Usually this is a valid approach where the pines are scattered at random on the site. But *Pinus ponderosa* reaches its environmental limits at upper elevations of ABGR/ACGL. In these situations the pines may appear to be randomly distributed to the casual observer but with closer inspection prove to be restricted to convex topography, especially the upper portions of small ridges. Conversely, the pines may be largely absent from the concave terrain of small drainages and toeslopes. These sites may be within the elevational range of *Pinus ponderosa*, but factors other than low temperatures, such as snow damage and shrub competition, preclude the pines' development. If *Pinus ponderosa* is planted across these sites without regard for the often subtle differences in terrain, merchantable trees may develop only on the convex areas where naturally established pines once stood. The intervening concave areas may be more suitable for *Pseudotsuga*, which is more tolerant of snow bending and tall shrub competition.

The genetic source of *Pinus ponderosa* seed is also a critical factor where snow damage hazards exist. Seed sources can vary widely in snow damage susceptibility and recovery (Rehfeldt and Cox 1975). In general, seedlings from lower elevation seed sources tend to grow faster and sustain more snow damage, whereas upper elevation seed sources grow more slowly and recover from snow damage more readily. In some areas, however, upper elevational limits of *P. ponderosa* may be due to deep snowpacks rather than low temperatures. Consequently, at upper elevations where the pine occurs naturally in only minor amounts, even pine plantations of the proper seed source may experience reduced stocking levels and may not be a major component of the stand by rotation age. Selecting seed sources having greater stockiness (Silen and Rowe 1971) may overcome the snow damage problem, but this has yet to be proven.

Growth and Yield Capability—Height-age data of free-growing trees, usually in clearcuts or burns, were collected during the course of this study. These data provided growth information for the younger age classes of major tree species in ABGR/ACGL. Similar data in older age classes were taken from dominant or codominant trees in old-growth stands during this study and the habitat type classification study (Steele and others 1981). Increment cores of these older trees were examined for evidence of suppression. If the core indicated past suppression, or if it was too far from the pith to allow a confident estimate of total age, the tree was rejected. Remaining data were used to estimate site index and yield capability.

Estimates of site index and yield capability stem from three sources. The *Pseudotsuga* site index was plotted from Monserud's (1985) site curves, but because no yield tables exist for *Pseudotsuga*, Brickell's (1970) *Pinus ponderosa* yield curve was used. The *Pinus ponderosa* site index and yield capability were derived from Brickell's (1970) site curves, which are a conversion to a 50-year base age from Lynch (1958). The *Abies grandis* site index and yield capability were derived from Stage (1959) and Brickell (1970), respectively. The values, however, were read from graphs, rather than using equations that require crown ratios—an unavailable input.

Growth and yield capabilities of the ABGR/ACGL h.t. are shown in table 5. *Pinus ponderosa* apparently produces more volume than *Pseudotsuga* in the PHMA phase but less volume than *Pseudotsuga* in the ACGL phase. This relationship conforms to the observation that the pine is more widely adapted to the PHMA phase than the ACGL phase. The *Pseudotsuga* yields greater volume in the ACGL phase where it establishes more readily.

SUMMARY OF TREE LAYER SECTION

Populus tremuloides is the least tolerant of succession, followed by *Pinus ponderosa*, *Pseudotsuga*, *Picea*, and finally *Abies grandis*. *Pinus ponderosa* does not always occur on sites that support *Picea*, *Alnus*, *Ribes lacustre*, or *Actaea* and may grow poorly there if planted. *Pseudotsuga* and *Picea* usually require protection from sun and wind in order to establish. The *Picea* generally becomes well represented only on the moister sites that support *Alnus*, *Ribes lacustre*, or *Actaea*. *Abies grandis* regenerates easily throughout the ABGR/ACGL habitat type. It may be free of heartrot in the drier PHMA phase.

Pocket gophers may become a problem following machine scarification of the site or frequent partial cutting of the stand. Broadcast burning following a single stand entry minimizes gopher populations but encourages shrub competition for pine seedlings. Conversely, machine scarification encourages pocket gophers but minimizes competition for planted pines. Where competition of residual shrubs is a major problem, managing for *Pseudotsuga* should be considered.

Snow damage to pine plantations occurs frequently in ABGR/ACGL. Foresters should consult Megahan and Steele (1988) for assessing snow damage potential of scheduled plantations **before the timber sale.** Where snow damage hazards are high, managing for *Pseudotsuga* should be considered.

The Shrub Layer

Seral stages in the shrub layer are more diverse and less easily interpreted than in the tree layer because more species are involved. Environmental variation within the habitat type also contributes to this diversity. For example, *Alnus sinuata* occurs only in the moister portions of ABGR/ACGL, whereas

Table 5—Growth and yield characteristics of trees in the ABGR/ACGL h.t.

Tree species	Number of site trees	Site index (50-year base)	Number of stands	Yield capability
				Ft³/acre/year
ACGL phase:				
Abies grandis	*n* = 7	53 ± 15[1]	*n* = 6	102 ± 26
Pseudotsuga menziesii	*n* = 9	76 ± 11	*n* = 9	130 ± 41
Pinus ponderosa	*n* = 5	67 ± 13	*n* = 5	99 ± 38
PHMA phase:				
Abies grandis	*n* = 9	56 ± 10	*n* = 8	119 ± 17
Pseudotsuga menziesii	*n* = 12	67 ± 9	*n* = 12	100 ± 26
Pinus ponderosa	*n* = 9	75 ± 13	*n* = 8	130 ± 44

[1]95 percent confidence intervals.

Spiraea betulifolia occurs mostly in the drier extremes that merge with the ABGR/SPBE h.t. Table 6 lists the shrub species that may become well represented in ABGR/ACGL and shows which species occur in only part of the habitat type. These partial occurrences often reflect an affinity with adjacent habitat types that are either cooler and wetter or warmer and dryer than ABGR/ACGL. Consequently, shrub layer succession near environmental extremes of ABGR/ACGL may resemble that of the adjacent habitat type rather than a modal ABGR/ACGL site.

A total of 80 shrub layers were sampled in the ABGR/ACGL h.t., ACGL phase and 76 were sampled in the PHMA phase. Among these stands there are eight major indicator species and three alternates. The alternate indicator species may occur in only part of the habitat type or may supplement the occurrence of another species that can grow throughout the habitat type. In either case, species are grouped according to similar ecological amplitudes and successional strategies. For instance, *Ribes lacustre* was grouped with *R. viscosissimum* because both species have seeds that store in the ground and respond to scarification. *Symphoricarpos albus* was grouped with *Spiraea* because both species are rhizomatous and moderately shade tolerant. A few other taxa such as *Sorbus*, *Lonicera*, and *Prunus* were only occasionally well represented and were not used for classification purposes.

Relative successional amplitudes of major shrub species in ABGR/ACGL provide the basis for shrub layer classification and are shown in figure 11. These amplitudes were derived from many field observations and sample data (appendix B). They are meaningful only in a relative sense because there is

Table 6—Successional role of major shrub species in phases of the ABGR/ACGL h.t.

ADP No.	Species	Abbreviation	Role[1] ACGL phase	PHMA phase
102	*Acer glabrum*	ACGL	C	c
104	*Alnus sinuata*	ALSI	(S)	a
105	*Amelanchier alnifolia*	AMAL	s	s
203	*Berberis repens*	BERE	c	c
198	*Ceanothus sanguineus*	CESA	(s)	(S)
107	*Ceanothus velutinus*	CEVE	(S)	S
204	*Clematis columbiana*	CLCO	c	(c)
115	*Lonicera utahensis*	LOUT	(S)	s
118	*Pachistima myrsinites*	PAMY	(C)	(C)
122	*Physocarpus malvaceus*	PHMA	(C)	C
123	*Prunus emarginata*	PREM	(S)	(S)
124	*Prunus virginiana*	PRVI	a	a
128	*Ribes cereum*	RICE	a	(s)
130	*Ribes lacustre*	RILA	(S)	a
131	*Ribes viscosissimum*	RIVI	S	S
133	*Rosa gymnocarpa*	ROGY	s	s
161	*Rosa nutkana*	RONU	(s)	s
136	*Rubus parviflorus*	RUPA	S	S
137	*Salix scouleriana*	SASC	S	S
164	*Sambucus cerulea*	SACE	(s)	s
138	*Sambucus racemosa*	SARA	(s)	a
139	*Shepherdia canadensis*	SHCA	(s)	(s)
140	*Sorbus scopulina*	SOSC	c	(c)
142	*Spiraea betulifolia*	SPBE	S	S
143	*Symphoricarpos albus*	SYAL	(S)	(S)
163	*Symphoricarpos oreophilus*	SYOR	(S)	s
146	*Vaccinium globulare*	VAGL	(C)	(C)

[1]S = major seral; s = minor seral; C = major climax; c = minor climax; a = accidental; () = occurs in only part of the phase, usually the moister portion or the warmer-drier portion.

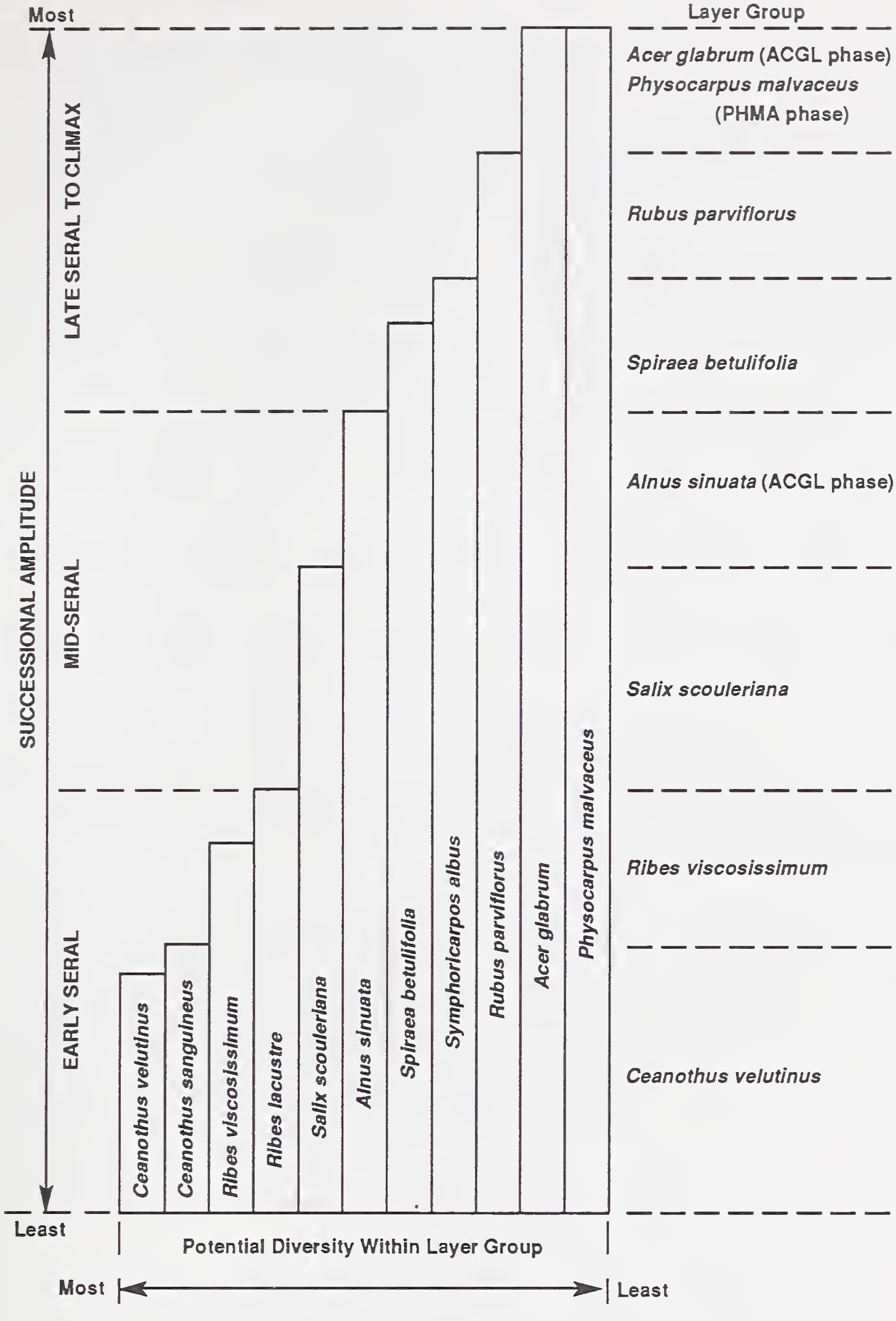


Figure 11—Relative successional amplitudes of major shrub species in the ABGR/ACGL h.t.

no scale for measurement. Ideally, relative amplitudes (fig. 11) should be established through long-term studies of many permanent plots, but rarely is such a study attempted. The accuracy of these relative amplitudes varies. In some cases these are well-established trends (as in the tree layer), but in other cases they are the authors' best guess. This accuracy is greatest for the species farthest apart. For example, *Ceanothus* and *Ribes* clearly have less successional amplitude than *Acer*, but the relative amplitudes of *Spiraea* versus *Rubus* are less certain.

From the relative amplitudes (fig. 11), succession classification diagrams for the shrub layer are easily constructed (figs. 12, 13). The entire classification consists of 8 shrub layer groups and 34 layer types. Of the 34 possible layer types, 32 occur in the

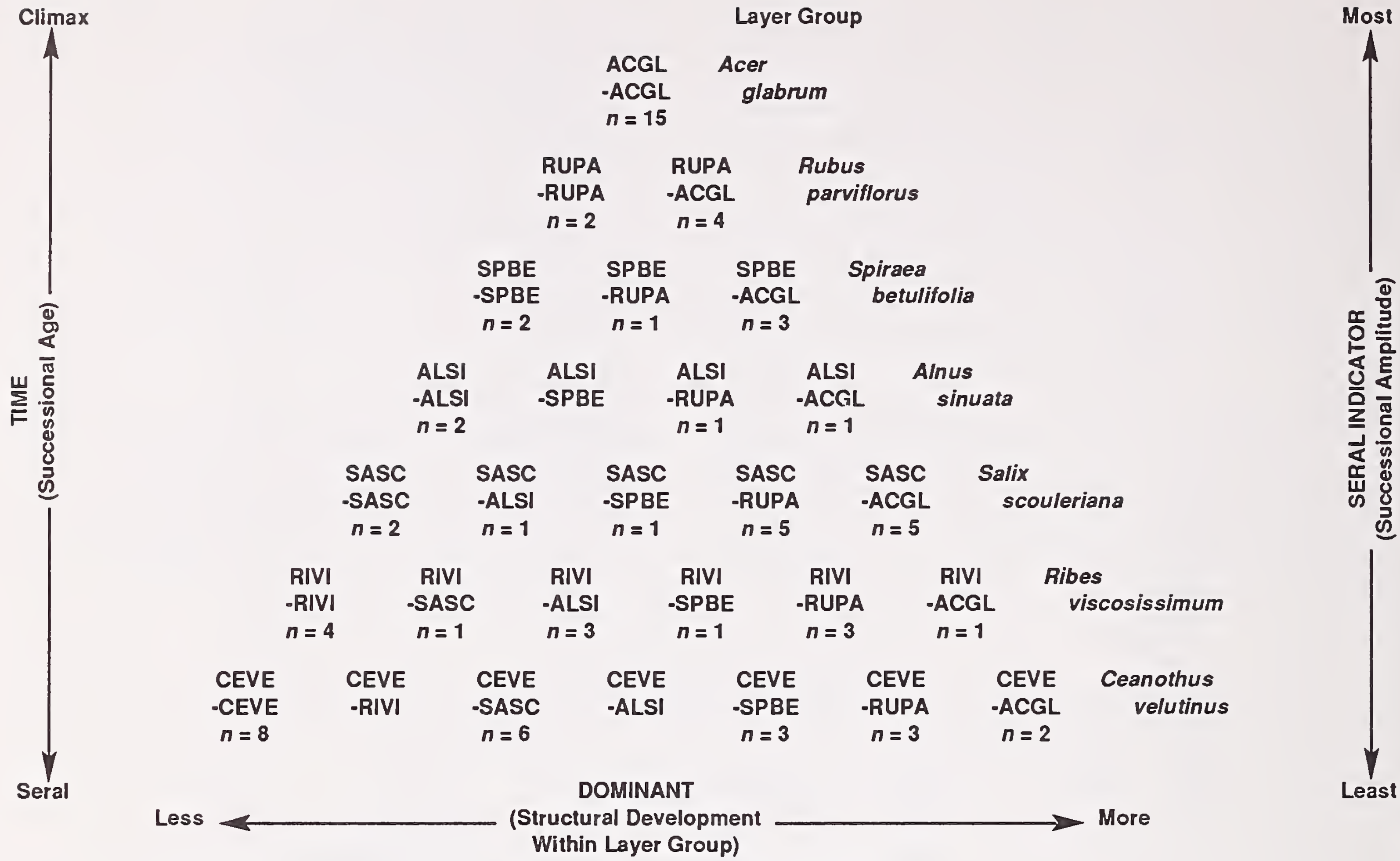


Figure 12—Succession classification diagram of the shrub layer in the ABGR/ACGL h.t., ACGL phase (*n* = number of samples in each layer type).

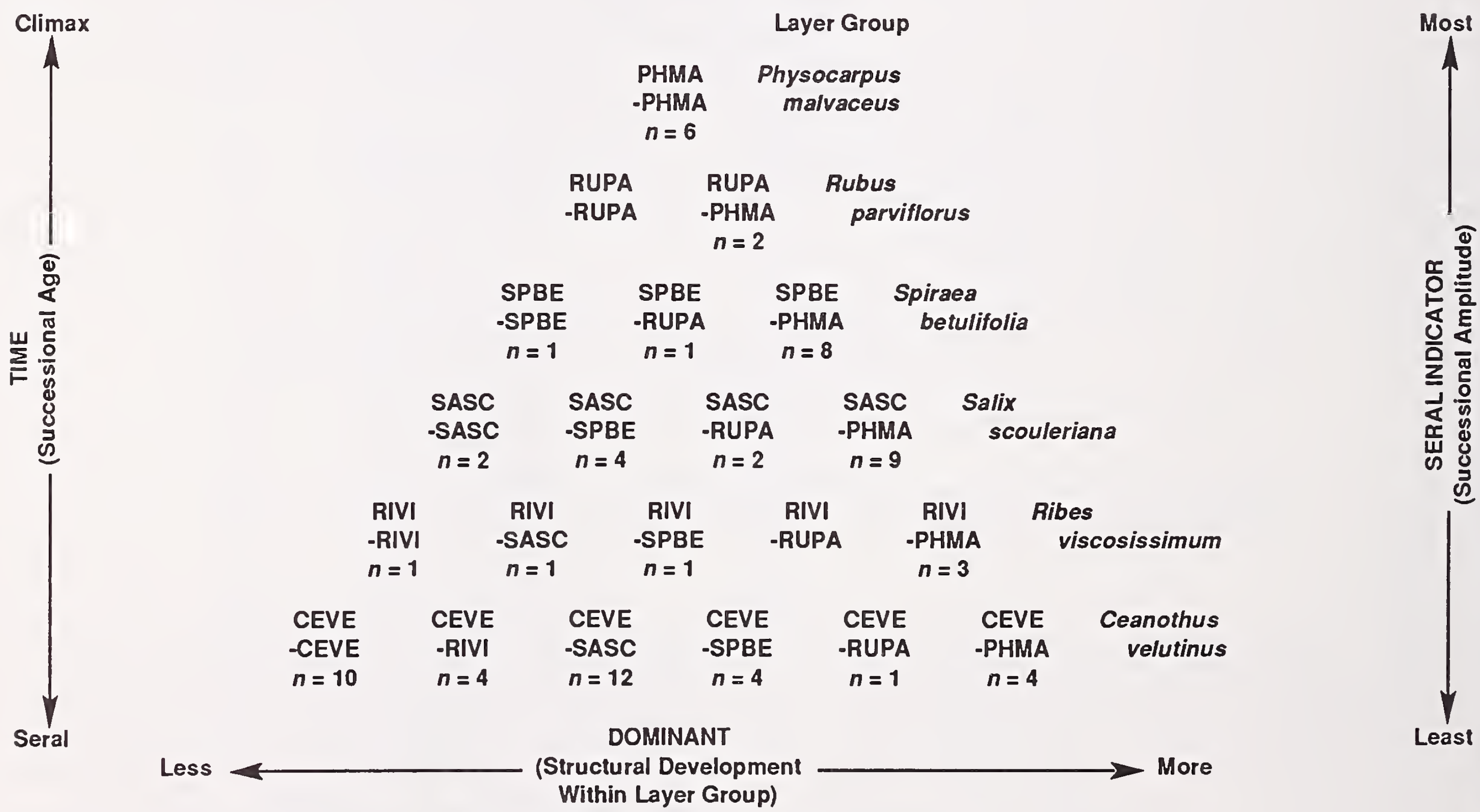


Figure 13—Succession classification diagram of the shrub layer in the ABGR/ACGL h.t., PHMA phase (*n* = number of samples in each layer type).

present data set (figs. 12, 13). The remaining layer types may eventually be found following uncommon disturbances (or disturbance combinations) or may be rare under any circumstance.

The classification diagrams (figs. 12, 13) are easily converted to a systematic key for field use (table 7). Indicator species (of layer groups) appearing early in the key have the least successional amplitude and so have greater indicator value than species with more amplitude which appear progressively later in the key. This same ranking of indicator value is used to select the dominant indicator for layer types when several species codominant the site. Alternate indicator species (fig. 11) appear with their appropriate primary indicator throughout the key (table 7).

The range of years since disturbance of sampled layer types appears in appendix B; averages are given when three or more known ages exist per layer type. The low extreme of each range is meaningless because any layer type could have been recently disturbed; in these cases only disturbance intensity would vary between layer types. The averages and upper extremes show a gradual though sporadic increase, with successionally older layer types. This general progression of both years and layer types demonstrates that both entities delineate time, though in different ways. But years since the last disturbance can be misleading because some shrub layers were not caused by the last disturbance but merely survived it. This is particularly true with disturbances of low intensity.

CEANOTHUS VELUTINUS LAYER GROUP (CEVE L.G.)

Ceanothus velutinus is a shade-intolerant nonrhizomatous shrub with values for big-game browse, songbird habitat (Thomas 1979), and nitrogen fixation (Youngberg and Wollum 1976). It has no apparent means of long-distance seed dispersal, but it is likely that small birds eat and transport some seed. Small rodents feed on the fruits and may provide short-distance dispersal. Most seed, however, simply falls to the ground and can remain viable in the soil and duff for at least 200 to 300 years (Gratkowski 1962) and possibly over 500 years (Zavitkovski and Newton 1968). Kramer (1984) found viable *Ceanothus* seed buried in 94 percent of the near-climax ABGR/ACGL sites that he sampled. The seed germinates readily following a burn and usually in direct proportion to burning intensity. Following a severe wildfire or broadcast burn, *Ceanothus* is usually the first shrub to dominate from seed. It attains some of its greatest development in the ABGR/ACGL h.t. where heights of 5 to 6 ft (1.5 to 1.8 m) are not uncommon and occasionally 7 ft (2.2 m) in height was recorded. In some

Table 7—Key to shrub layer groups and layer types, with ADP codes, in the ABGR/ACGL h.t.

		ADP codes
1. *Ceanothus velutinus* (incl. *C. sanguineus*) well represented[1]	CEVE LAYER GROUP	107
1a. *Ceanothus* spp. dominant	CEVE-CEVE Layer Type	107.107
1b. *Ribes* spp. dominant or codominant	CEVE-RIVI Layer Type	107.131
1c. *Salix scouleriana* (incl. *Prunus* spp.) dominant or codominant	CEVE-SASC Layer Type	107.137
1d. *Alnus sinuata* dominant or codominant	CEVE-ALSI Layer Type	107.104
1e. *Spiraea* spp. or *Symphoricarpos albus* dominant or codominant	CEVE-SPBE Layer Type	107.142
1f. *Rubus parviflorus* dominant or codominant	CEVE-RUPA Layer Type	107.136
1g. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	CEVE-ACGL[2] Layer Type	107.102
1. *Ceanothus* spp. poorly represented	2	
2. *Ribes viscosissimum* (incl. *R. lacustre*) well represented	RIVI LAYER GROUP	131
2a. *Ribes* spp. dominant	RIVI-RIVI Layer Type	131.131
2b. *Salix scouleriana* (incl. *Prunus* spp.) dominant or codominant	RIVI-SASC Layer Type	131.137
2c. *Alnus sinuata* dominant or codominant	RIVI-ALSI Layer Type	131.104

(con.)

		ADP codes
2d. *Spiraea* spp. or *Symphoricarpos albus* dominant or codominant	RIVI-SPBE Layer Type	131.142
2e. *Rubus parviflorus* dominant or codominant	RIVI-RUPA Layer Type	131.136
2f. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	RIVI-ACGL[2] Layer Type	131.102
2. *Ribes* spp. poorly represented	3	
3. *Salix scouleriana* (incl. *Prunus* spp.) well represented	SASC LAYER GROUP	137
3a. *Salix* (incl. *Prunus* spp.) dominant	SASC-SASC Layer Type	137.137
3b. *Alnus sinuata* dominant or codominant	SASC-ALSI Layer Type	137.104
3c. *Spiraea* spp. or *Symphoricarpos albus* dominant or codominant	SASC-SPBE Layer Type	137.142
3d. *Rubus parviflorus* dominant or codominant	SASC-RUPA Layer Type	137.136
3e. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	SASC-ACGL[2] Layer Type	137.102
3. *Salix* (incl. *Prunus* spp.) poorly represented	4	
4. *Alnus sinuata* well represented	ALSI LAYER GROUP	104
4a. *Alnus* dominant	ALSI-ALSI Layer Type	104.104
4b. *Spiraea* spp. or *Symphoricarpos albus* dominant or codominant	ALSI-SPBE Layer Type	104.142
4c. *Rubus parviflorus* dominant or codominant	ALSI-RUPA Layer Type	104.136
4d. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	ALSI-ACGL[2] Layer Type	104.102
4. *Alnus* poorly represented	5	
5. *Spiraea betulifolia* (incl. *Symphoricarpos albus*) well represented	SPBE LAYER GROUP	142
5a. *Spiraea* spp. or *Symphoricarpos albus* dominant	SPBE-SPBE Layer Type	142.142
5b. *Rubus parviflorus* dominant or codominant	SPBE-RUPA Layer Type	142.136
5c. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	SPBE-ACGL[2] Layer Type	142.102
5. *Spiraea* (incl. *Symphoricarpos albus*) poorly represented	6	
6. *Rubus parviflorus* well represented	RUPA LAYER GROUP	136
6a. *Rubus* dominant	RUPA-RUPA Layer Type	136.136
6b. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) dominant or codominant	RUPA-ACGL[2] Layer Type	136.102
6. *Rubus* poorly represented	7	
7. *Acer glabrum* (incl. *Physocarpus* and *Vaccinium*) well represented	ACGL[2] LAYER GROUP	102
7a. *Acer* (incl. *Physocarpus* and *Vaccinium*) dominant	ACGL-ACGL[2] Layer Type	102.102
7. *Acer* (incl. *Physocarpus* and *Vaccinium*) poorly represented	depauperate or unclassified shrub layer	

[1]"Well represented" means canopy coverage ≥5 percent. "Dominant" refers to greatest canopy coverage regardless of height; "codominant" refers to nearly equal canopy coverage. When keying to layer type, choose first condition that fits.
[2]Substitute "*PHMA*" for "*ACGL*" when applying key to *Physocarpus* phase.

lower elevations of ABGR/ACGL, *C. sanguineus* will occur instead of *C. velutinus*, but its successional role appears the same.

The CEVE layer group represents some of the most common early seral shrub layers in ABGR/ACGL. Of the eight CEVE layer types that may occur (figs. 12, 13) only CEVE-ALSI was not found. CEVE-ALSI is a rare layer type because *Ceanothus* and *Alnus* seldom grow on the same site. Sites that are wet enough to support *Alnus* are usually too wet for *Ceanothus*. Species indicative of these wetter sites include *Picea*, *Actaea*, and high coverages of *Ribes lacustre*.

The CEVE layer types are typically a response to various intensities of burning but can also appear following scarification. Severe burns can produce a CEVE-CEVE layer type. Less severe burns may produce the other CEVE layer types (figs. 12, 13) depending on preburn composition. For example, burning a shrub layer composed primarily of *Salix*, *Physocarpus*, or *Acer* could produce a CEVE-SASC, CEVE-PHMA, or CEVE-ACGL layer type, respectively. Thorough scarification (as from bulldozer-piling of logging slash) could produce a CEVE-RIVI layer type. CEVE layer types are perhaps the easiest shrub layers to achieve following disturbance and respond dependably to burning on slopes with good cold air drainage. Such slopes are characteristic of the ABGR/ACGL h.t. These shrub layers are a practical cover for protecting disturbed sites. A dense canopy of *Ceanothus* (generated by a high-intensity burn) will deter livestock and erosion; a light canopy (generated by a low-intensity burn or scarification) can provide shelter for *Pseudotsuga* seedlings (Youngberg and others 1979). CEVE layer types can generally progress successionally to most other shrub layer groups, but succession of individual stands is determined by species composition and canopy cover.

RIBES VISCOSISSIMUM LAYER GROUP (RIVI L.G.)

Ribes viscosissimum and *R. lacustre* are characteristically early seral nonrhizomatous shrubs which become well represented on thoroughly scarified sites. They are shade intolerant and begin declining whenever shaded by taller vegetation. The *Ribes*, however, seem to maintain themselves longer toward climax than does *Ceanothus* (appendix B) and so are considered slightly less vulnerable to succession (fig. 11). Like *Ceanothus*, numerous seeds of *Ribes* fall to the ground and remain viable in the soil and duff long after the parent shrubs have disappeared. But because *Ribes* have a fleshy fruit, many seeds are also dispersed by birds and mammals. These transported seeds can also store in the soil for many years. Kramer (1984) found *Ribes* seed buried in 75 percent of the near-climax ABGR/ACGL sites that he sampled. Although *R. viscosissimum* may occur throughout ABGR/ACGL, *R. lacustre* is more restricted to wetter sites that can also support *Alnus*, *Picea*, and *Actaea*.

The classification diagrams (figs. 12, 13) show seven possible layer types in the RIVI l.g. All of these were found although the RIVI-RUPA layer type has not yet been found in the ABGR/ACGL h.t., PHMA phase (fig. 13). In general, the RIVI layer types originate from various types of scarification without burning (figs. 14, 15). They are most common in scarified portions of past pile-and-burn operations and rarely occur on burned areas. But most sites in ABGR/ACGL are too steep for machine scarification, and RIVI layer types are scarce even though adequate *Ribes* seed is present.

The RIVI layer types, and especially RIVI-RIVI, generate the least competition for tree seedlings of any early to mid-seral shrub layer in ABGR/ACGL. The maximum height of *Ribes* is about 3 ft (0.9 m), and although this height is attained within 5 years, the canopy is sparse and should not outcompete *Pinus ponderosa* seedlings. Consequently, RIVI layer types will permit replanting of tree seedlings more readily than the other shrub layer types. These layer types generally have low forage values for big game and livestock.

SALIX SCOULERIANA LAYER GROUP (SASC L.G.)

Salix scouleriana is a nonrhizomatous shrub that has high value for big-game browse (appendix B). It can also provide nesting and feeding habitat for small birds and site protection for conifer seedlings. Its light, windblown seeds are dispersed in late spring, have short-lived viability, and require moist mineral soil for germination (Brinkman 1974). Though *Salix* is only slightly tolerant of shade, its tall growth habit—up to 30 ft (9 m) in ABGR/ACGL—and sprouting ability enable it to persist in small openings on well-timbered sites.

Prunus emarginata is a moderately shade-tolerant shrub that generates many root sprouts and tends to form thickets. It provides important food and cover for birds and mammals, which disperse the heavy flesh-covered seed in the fall. The seeds remain viable in the soil and duff for many years (Kramer 1984) and have an embryo dormancy that is offset by winter conditions (Grisez 1974). Following a major disturbance, particularly burning, the seeds will germinate in early spring but rarely form a dense stand in ABGR/ACGL. Because of its infrequent occurrence in ABGR/ACGL, *P. emarginata* is grouped with *Salix* as an alternate indicator of mid-seral conditions.

Figure 14—RIVI-RIVI shrub layer type on West Mountain west of Cabarton, ID, in 1987. Stand was partially logged and thoroughly scarified in 1981. *Ribes viscosissimum*, germinated profusely from buried seed in response to scarification, now dominates the shrub layer.

Figure 15—RIVI-ALSI shrub layer type in Pine Creek drainage west of Smiths Ferry, ID, in 1984. Area was partially logged and well scarified in 1976. *Ribes viscosissimum* germinated from buried seed in response to scarification. *Alnus* from wind-borne seed (and possibly stump sprouts) now dominates the shrub layer.

Figure 16—SASC-PHMA shrub layer type west of Smiths Ferry, ID, in 1984. Area experienced stand-destroying wildfire in about 1936. *Salix scouleriana* and *Physocarpus malvaceus* now codominate the site. *Prunus emarginata* also well represented. *Ceanothus velutinus* was likely well represented following the burn but has declined beneath the *Salix* canopy. *Abies grandis* (in trace amounts) is the only conifer present.

SASC layer types represent mid-seral stages of shrub layer succession and consist of six layer types in ABGR/ACGL (figs. 12, 13). All of these have been sampled, with SASC-ALSI being the least common.

In the past, SASC layer types resulted from severe wildfires (fig. 16), which exposed patches of bare mineral soil in moist areas. Broadcast burn operations tend to duplicate this effect but often do not burn hot enough to create an adequate seedbed for *Salix*. SASC layer types have developed following mechanical scarification in clearcuts, especially where exposed soil was mounded so as to trap water behind the mounds, thus creating well-watered seedbeds of mineral soil. In spring, mechanical treatments can also result in vegetative increase of *Salix* by breaking the branches into short pieces that strike root in wet soil. These "vegelings" have a growth curve similar to seedlings (as opposed to stump sprouts) since a new root system must develop. Most stands sampled in this layer group experienced a severe wildfire about 40 to 80 years ago. Some stands had received partial cutting and some scarification more recently, but the shrub layer appears to have merely survived these disturbances rather than resulted from them.

SASC layer types may enhance *Pseudotsuga* or *Picea* establishment by protecting the site from wind and intense sunlight, but these tall shrub layers are a formidable competitor of *Pinus ponderosa* seedlings. *Salix* particularly is a serious problem. Having a low tolerance for shade, the pine seedling must outgrow *Salix* in order to survive. This is barely possible when *Salix* seedlings are involved, because planted pine and *Salix* seedlings have similar growth rates for about the first 9 years. But when the *Salix* arises from stump sprouts that can outgrow the pine in the first year, the pine seedling has little chance for survival. Even when contour strips or terraces are installed next to *Salix* stumps, the pine is shaded out by the height and lateral spread of the *Salix*. In full sunlight, *Salix* stumps can produce tall, rounded shrubs up to 16 ft (4.9 m) in diameter. Consequently, timbered stands with a *Salix* density of at least one every 16 ft (4.9 m) may lack potential growing space for pine seedlings following clearcutting or wildfire. Such sites may require special mechanical or chemical treatment following clearcutting where pine plantations are a management objective. In these situations, managing for *Pseudotsuga* or *Picea* may be the preferred alternative.

ALNUS SINUATA LAYER GROUP (ALSI L.G.)

Alnus sinuata is a nonrhizomatous seral shrub that has little forage value but provides habitat for small birds and mammals and fixes nitrogen in the soil (Mitchell 1968). Though only slightly shade tolerant, its widely spreading growth habit enables it to persist on well-timbered sites by intercepting sunlight that passes through the tree canopy. *Alnus* has a small, wind-disseminated seed that germinates on moist mineral soil as well as moss mats. Although it generally forms thickets from seed, the *Alnus* can also sprout from stumps and reach a maximum height of 10 to 13 ft (3.0 to 4.0 m). High coverages of *Alnus* occur in only the wetter portions of ABGR/ACGL and indicate sites suitable for *Picea engelmannii* and generally unsuitable for *Ceanothus velutinus* and possibly *Pinus ponderosa*.

ALSI layer types represent mid-seral shrub layers in ABGR/ACGL and consist of four layer types, three of which were found (fig. 12). It is not widespread in ABGR/ACGL but can appear unexpectedly following clearcutting and scarification. The rapid growth rate of *Alnus* may preclude success of *Pinus ponderosa* seedlings, making it imperative to recognize potential *Alnus* sites before planting. The presence of *Alnus* is the best indicator of such conditions, but the presence of *Actaea*, *Circaea*, or a high density of *Picea* or *Ribes lacustre* generally indicates sites wet enough for *Alnus* invasion.

Most of the ALSI layer types sampled occurred where the dominant trees had been removed and the site was partially shaded by scattered second growth. The sites had been scarified from skidding the large trees. The *Alnus* had colonized these sites from a nearby seed source. An occasional residual *Alnus* had been rejuvenated by the logging and also contributed to the seed supply.

SPIRAEA BETULIFOLIA LAYER GROUP (SPBE L.G.)

Spiraea betulifolia is a moderately shade-tolerant rhizomatous shrub with root development well down in the soil profile. Being rhizomatous, *Spiraea* usually grows in extensive colonies. Mechanical scarification and stripping seldom remove completely the *Spiraea* root system, which will resprout within the next growing season. *Spiraea* produces a small seed that has no obvious means of dispersal, although occasional transport by small birds and rodents as well as strong winds seems likely. Its seedlings are rarely found. *Spiraea* has moderate forage value for mule deer and elk (appendix B).

Symphoricarpos albus may be slightly more shade tolerant than *Spiraea* (fig. 11) but is treated as a successional equivalent in ABGR/ACGL. Like *Spiraea*, *Symphoricarpos albus* develops extensive rhizomes that usually resprout following scarification of the site. It also provides moderate forage value for deer and elk (appendix B).

SPBE layer types occur mainly in drier portions of ABGR/ACGL. They are treated here as a late-seral stage of shrub layer succession but may represent a near-climax stage (especially SPBE-ACGL and SPBE-PHMA) when occurring on sites transitional to the grand fir/white spirea habitat type. There are three SPBE layer types, all of which were sampled (figs. 12, 13). These layer types generally resulted from succession following wildfire 50 to 100 years ago. A few stands had received some logging more recently, but the shrub layer was not substantially altered. Intense burning in these layer types will likely rejuvenate the small amounts of early and mid-seral shrub species that remain in the stand, as well as produce a layer of *Ceanothus*. The resulting shrub layer may be considerably taller and more dense than the present condition.

RUBUS PARVIFLORUS LAYER GROUP (RUPA L.G)

Rubus parviflorus is a moderately shade-tolerant rhizomatous shrub with considerable forage value for deer and elk. The fruits are sought by bear, birds, and small mammals, all of which disperse the seed. Its seed can store in the soil for many years and germinate following burning (Kramer 1984). Once established, the *Rubus* can spread rapidly in openings and form large patches, which then persist beneath a tree canopy. If the tree canopy is reduced while *Rubus* is present, the shrub's rhizomatous nature enables it to quickly increase in cover.

There are three RUPA layer types in ABGR/ACGL, and all were found. They are common in the ACGL phase but become scarce in the drier PHMA phase. These layer types resulted either from succession following wildfire 40 to 80 years ago, or from an increase of suppressed *Rubus* following a reduction of the tree canopy. Although easily rejuvenated by logging or wildfire, RUPA layer types are not likely created through direct seedling establishment.

ACER GLABRUM LAYER GROUP (ACGL L.G.)

Acer glabrum is a nonrhizomatous but highly shade-tolerant shrub that can persist beneath all but the densest tree canopy. It produces a fairly heavy, winged seed that does not store in the soil (Kramer 1984). *Acer* seedlings were found only beneath partial shade, usually where the soil had been lightly scarified. Initially they grow slowly. Seedlings 4 to 6 inches (10.2 to 15.2 cm) tall were 9 to 18 years old and had a tap root longer than 12 inches (30.5 cm). The rate of top growth likely increases once the roots have encountered adequate moisture. Maximum height is 12 to 14 ft (3.6 to 4.3 m) in ABGR/ACGL. Well-established *Acer* can produce

vigorous sprouts in full sun. Stump sprouts can reach 6 to 7 ft (1.8 to 2.1 m) in 10 years and provide important forage for deer and elk (appendix B).

The ACGL l.g. occurs only in the ACGL phase of ABGR/ACGL. Because it represents climax conditions, only one layer type exists (fig. 12). The ACGL-ACGL layer type is generally the result of long-term succession, even though it may be present following clearcutting (usually without site treatment). Because *Vaccinium globulare* and *Physocarpus* are also climax species, they are treated as alternate indicators of the ACGL layer type. The more shallow root systems of these two species make them more susceptible to disturbance than the deep-rooted *Acer*. But their rhizomatous nature also enables them to increase more rapidly. The ACGL-ACGL layer type is not apt to be achieved through site manipulation except possibly under a shelterwood. Of the 15 stands sampled in this layer type, most occurred beneath a canopy of pole-size to old-growth trees, even though some stands contained evidence of repeated burning. A few sites had been logged but had received no site preparation that would give rise to an early seral shrub layer.

PHYSOCARPUS MALVACEUS LAYER GROUP (PHMA L.G.)

Physocarpus is a shade-tolerant rhizomatous shrub that occurs throughout much of the ABGR/ACGL habitat type. Its coverage can be reduced by mechanical scarification, intense burning, or repeated browsing (Daubenmire and Daubenmire 1968), but its potential for resprouting from an extensive root system may result in rapid recovery. The seeds of *Physocarpus* are small, with no obvious means of long-distance dispersal but are likely dispersed by small birds and rodents. Although they store in the soil, their viability is low (Kramer 1984). Seedlings are uncommon but were found beneath partial shade where the soil had been lightly scarified. Maximum height of *Physocarpus* in ABGR/ACGL is 3 to 4 (occasionally 5) ft (0.9 to 1.2 [occasionally 1.5] m).

The PHMA l.g. occurs in the PHMA phase of ABGR/ACGL and is the climax counterpart of the ACGL l.g. in the ACGL phase. Because it represents a climax condition, only one layer type exists (fig. 13). The PHMA-PHMA layer type is the result of long-term succession and is not apt to be achieved through site manipulation. But sites that are clearcut with no site treatment occasionally remain in this layer type. In these situations, burning or scarification to help establish early or mid-seral shrub species would improve the habitat for wildlife as well as create microsites for tree seedling establishment.

MANAGEMENT IMPLICATIONS

The previous sections describe some layer groups that can be achieved through prescribed site treatments and others that result mainly from uninterrupted succession. The actual layer type that may result from a particular site treatment can often be projected on a stand-by-stand basis from species composition and known successional response of the species present. When land managers consider the possible shrub layer types that can result from alternative site treatments, they may also wish to consider the relative forage value of these layer types for big game and livestock. Such values can be estimated from relative palatability ratings of plant species for elk (Kufeld 1973), deer (Kufeld and others 1973), cattle and sheep (USDA Forest Service 1986), and black bear (Beecham 1981). The scale of 1 to 3 in these studies was expanded to 1 to 6 so as to emphasize the differences in palatability values. The relative palatability value for each shrub species is listed in appendix B. This value was multiplied by the percentage occurrence (constancy) and average canopy cover for that species in a given layer type (appendix B). This step was repeated for all species in the layer type. The index values were then reduced to classes in order to simplify forage value assessments and to eliminate the false impression of high precision between values (tables 8, 9).

These index classes reflect forage potential on a relative basis but do not necessarily reflect actual use, which is affected by juxtaposition of the surrounding vegetational types. Some index values may be biased by consistent disproportions of canopy cover to shrub volume. Likewise, palatability within a species can vary with plant vigor; however, other sources of variation common to this type of comparison have been reduced. For instance, the possibility of ecotypes (and different palatabilities) within a plant species is reduced by restricting the data to one habitat type. Individual animals may have slightly different forage preferences, but all possible layer types can be made available to the same group of animals. Plant species' palatabilities are listed by season to accommodate seasonal forage preferences. In spite of the shortcomings inherent with these kinds of comparisons, the forage index classes can provide general guidelines to relative browse potential for specific wildlife and range objectives as well as multifunctional planning. Range and wildlife managers who may have better species palatability ratings for a local area can easily recalculate the forage indexes from appendix B, reduce the indexes to index classes (tables 8, 9), and apply the results to their area.

Forage index classes vary according to kinds and amounts of plant species comprising the layer type.

Table 8—Relative index classes to big-game and livestock forage preferences by shrub layer type in the ABGR/ACGL h.t., ACGL phase[1]

Layer group / Layer type	Number of stands	Deer SU[2]	Deer W	Elk SU	Elk W	Cattle SU	Sheep SU	Black bear SP	Black bear SU	Black bear F
Ceanothus velutinus										
CEVE-CEVE	8	[3]7	5	8	7	3	4	1	1	1
CEVE-SASC	6	7	5	7	6	3	5	1	1	1
CEVE-SPBE	3	5	4	6	6	3	4	0	1	1
CEVE-RUPA	3	6	5	7	5	3	4	1	3	2
CEVE-ACGL	2	6	5	6	5	2	4	1	2	2
Ribes viscosissimum										
RIVI-RIVI	4	4	4	5	4	2	3	1	3	2
RIVI-SASC	1	2	2	3	3	1	2	0	1	1
RIVI-ALSI	3	4	4	6	4	3	4	1	3	2
RIVI-SPBE	1	2	2	3	3	1	2	0	1	1
RIVI-RUPA	3	4	4	6	4	2	4	1	3	2
RIVI-ACGL	1	2	3	3	3	2	2	1	2	1
Salix scouleriana										
SASC-SASC	2	5	5	5	5	2	3	1	1	2
SASC-ALSI	1	5	4	6	4	3	5	1	2	1
SASC-SPBE	1	2	2	2	2	1	2	0	0	0
SASC-RUPA	5	6	5	8	5	3	5	2	3	2
SASC-ACGL	5	6	4	6	4	2	4	1	3	2
Alnus sinuata										
ALSI-ALSI	2	6	5	7	5	4	6	1	3	2
ALSI-RUPA	1	5	4	7	4	3	5	1	3	1
ALSI-ACGL	1	4	4	5	4	3	4	0	1	1
Spiraea betulifolia										
SPBE-SPBE	2	2	2	3	3	1	2	1	1	1
SPBE-RUPA	1	3	2	4	3	2	3	1	2	2
SPBE-ACGL	3	5	5	6	5	3	5	1	3	3
Rubus parviflorus										
RUPA-RUPA	2	3	2	4	3	2	3	1	3	2
RUPA-ACGL	4	2	2	5	4	2	3	1	2	1
Acer glabrum										
ACGL-ACGL	15	3	3	3	3	2	2	0	1	1

[1]Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA FS (1986), and Beecham (1981).

[2]SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).

[3]Code to index classes:

0 = 0-50	1 = 51-150	2 = 151-250 (low)
3 = 251-350	4 = 351-450	5 = 451-550 (moderate)
6 = 551-650	7 = 651-750	8 = 751-850 (high)
9 = 851-950	10 = 951-1050	11 = 1051-1150 (very high)

Early seral layer types may need a larger data base to reflect modal vegetative conditions and forage indexes because early stages may contain more species. When the same layer type occurs in different habitat types or phases, variability of the index may increase with potential of the site and more samples may be needed for the more productive sites. The index value, however, is most affected by coverages of the most palatable species and does not necessarily increase with site productivity, although this often is the case. Ranking of species' nutritional value between habitat types and phases could add refinement to the index values. Such considerations should be made when comparing relative significance of forage index classes.

Deer—Shrub layer forage values for summer deer herds are generally highest in the CEVE and SASC layer groups, which mainly result from intense burning (tables 8, 9). The lowest values tend to occur in the RIVI layer group, created by scarification, and in the near-climax to climax layer groups such as SPBE, RUPA, ACGL, and PHMA. The CEVE-RUPA layer type had the highest deer forage value followed by the SASC-RUPA layer type. These

Table 9—Relative index classes to big-game and livestock forage preferences by shrub layer type in the ABGR/ACGL h.t., PHMA phase[1]

Layer group / Layer type	Number of stands	Deer SU[2]	Deer W	Elk SU	Elk W	Cattle SU	Sheep SU	Black bear SP	Black bear SU	Black bear F
Ceanothus velutinus										
CEVE-CEVE	10	[3]7	5	7	6	3	4	0	1	1
CEVE-RIVI	4	3	3	4	3	1	2	1	2	1
CEVE-SASC	12	5	4	6	5	2	4	0	1	1
CEVE-SPBE	4	5	4	6	5	3	4	1	1	1
CEVE-RUPA	1	9	7	11	7	4	7	2	4	2
CEVE-PHMA	4	6	4	6	4	2	4	0	0	0
Ribes viscosissimum										
RIVI-RIVI	1	2	3	3	3	1	2	1	2	2
RIVI-SASC	1	2	2	3	2	1	2	0	1	1
RIVI-SPBE	1	2	2	3	2	1	2	0	1	1
RIVI-PHMA	3	2	2	2	2	1	2	1	1	1
Salix scouleriana										
SASC-SASC	2	5	4	5	4	2	3	0	1	1
SASC-SPBE	4	4	3	5	5	2	4	1	1	1
SASC-RUPA	2	8	6	10	7	4	6	2	4	3
SASC-PHMA	9	5	4	6	4	2	5	1	2	1
Spiraea betulifolia										
SPBE-SPBE	1	2	1	2	2	1	2	0	0	0
SPBE-RUPA	1	5	3	7	3	2	5	2	4	2
SPBE-PHMA	8	3	2	3	2	1	3	0	1	1
Rubus parviflorus										
RUPA-PHMA	1	6	4	7	3	3	5	2	4	3
Physocarpus malvaceus										
PHMA-PHMA	6	1	1	1	1	1	1	0	0	0

[1]Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA FS (1986), and Beecham (1981).
[2]SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).
[3]Code to index classes:

0 = 0-50	1 = 51-150	2 = 151-250 (low)
3 = 251-350	4 = 351-450	5 = 451-550 (moderate)
6 = 551-650	7 = 651-750	8 = 751-850 (high)
9 = 851-950	10 = 951-1050	11 = 1051-1150 (very high)

conditions had exceptionally high coverages of *Salix* and *Rubus*, which were primarily responsible for the high forage values.

In winter, relative forage values tend to parallel those for summer but are usually lower. This may be irrelevant, however, because ABGR/ACGL sites tend to accumulate deep snow and are not likely to receive much deer use during winter.

Elk—In summer, elk forage values are highest mainly in the CEVE and SASC layer groups, with CEVE-CEVE, CEVE-RUPA, and SASC-RUPA having the highest values (tables 8, 9). These layer types were created mainly by past wildfire, even though some stands had experienced more recent disturbance. Some RIVI, ALSI, SPBE, and RUPA layer types also ranked high due to high coverages of associated highly palatable shrubs such as *Acer* and *Rubus* rather than the *Ribes*, *Alnus*, and *Spiraea*. The *Acer* and *Rubus* are easily rejuvenated by burning, which top-kills the shrubs and stimulates new growth.

In winter, forage values for elk are mostly low to moderate (tables 8, 9). But high values occur among several of the CEVE layer types and in SASC-RUPA. Due to snow depths, these layer types would probably be used in late fall and early spring rather than in midwinter.

Cattle—Forage values for cattle are low to moderate throughout shrub layer succession (tables 8, 9). Because shrub layers on these sites are usually dense and vigorous, associated herbaceous layers are usually sparse and add little to the total forage base. As a result, cattle use is often minor. Where large areas of ABGR/ACGL occur in cattle allotments, the cattle may use ABGR/ACGL sites disproportionately less and concentrate in recent clearcuts, riparian

zones, and other more favorable areas. Nearly all shrub layer types have corresponding values at least one class higher for deer and elk. This suggests that forage on ABGR/ACGL sites should be managed for deer and elk instead of cattle.

Sheep—Forage values for sheep are occasionally low but mostly moderate. The CEVE-RUPA and SASC-RUPA layer types ranked high in the PHMA phase, and ALSI-ALSI ranked high in the ACGL phase (tables 8, 9). In the CEVE and SASC layer groups, values for sheep were generally lower than corresponding values for deer and elk. The other layer groups, however, have nearly equal rankings for sheep and deer, but the values for elk remain somewhat higher. Consequently, the successional stage and composition of these shrub layers should be carefully assessed when allocating forage resources for the best use between sheep and deer or elk. In nearly all cases comparative rankings were higher for sheep than for cattle. This emphasizes further the inefficiency of allocating forage in ABGR/ACGL to cattle.

Black Bear—In spring, forage values for black bear are low in all stages of ABGR/ACGL succession. By summer, some shrub layers have moderate forage value due to the fruiting of shrubs such as *Amelanchier*, *Lonicera*, *Ribes*, *Rubus*, and *Vaccinium*. Layer types such as CEVE-RUPA, SASC-RUPA, SPBE-RUPA, and RUPA-PHMA (all in the PHMA phase) had the highest values. In fall, the shrub layers decline in forage value and most rank in the low category. A few layer types such as SASC-RUPA, SPBE-ACGL, and RUPA-PHMA had moderate forage value, which was due primarily to exceptionally high coverages of *Rubus* and *Vaccinium*. Forage rankings for bear, however, depend on fruit production, which is not always proportional to canopy cover. All of the above layer types except CEVE-RUPA are mid- to late-seral stages. These usually result from successional advance and are not likely to be created directly by site treatment. It would appear that black bear are more dependent on mid-seral shrub stages than are deer and elk, which can also benefit from early seral conditions.

Planted Tree Establishment and Shrub Competition—Potential shrub competition with tree seedlings is a function of existing vegetation, seed availability, site treatment, and habitat type or phase. The habitat type or phase classifies the environment, which in turn determines which species can occupy the site and the magnitude of their potential roles. For instance, *Acer* and *Physocarpus* can produce a major shrub layer in ABGR/ACGL but are of minor importance in many other habitat types. It is not always possible to predict what species will dominate following disturbance by simply inspecting the undisturbed site. Mature stands may contain a multitude of early seral species in the form of buried seed (Kramer 1984); other species establish by windblown seed. Inspection of adjacent disturbed areas can reveal some early seral species that occur in the mature stands as buried seed. Table 10 shows which shrubs in ABGR/ACGL store seed in the soil and important methods of seed dissemination, vegetative increase, and germination response to site treatment.

For instance, if *Ribes* occurs in the uncut stand, the existing *Ribes* canopy may increase somewhat following a clearcut with no site preparation (minor vegetative response) (table 10). If the clearcut is scarified, the scarification will reduce existing canopy cover, but the surviving plants will grow more vigorously due to the increased sunlight (minor vegetative response) and the buried *Ribes* seed will germinate in proportion to the scarification (major response from seed). Potential shrub competition for a given site is best estimated by noting kinds and amounts of existing shrubs on the site (and adjacent disturbed sites), the other species that may occur from buried or windblown seed, and reactions of these species to the site treatment planned (table 10). In contrast, generalized descriptions of site treatment and potential shrub responses tend to represent an average stand condition. Such predictions can be misleading for site-specific management because few stands would fit the average, and many plantations could be lost to unexpected competition.

Shrubs compete with tree seedlings for a number of years depending on height-age interactions of the species involved. Shrub growth rates in ABGR/ACGL are generalized in figure 17. For instance, properly planted *Pinus ponderosa* can outgrow most shrubs germinating from seed at the time of planting. An exception is *Ribes*, which may overtop the pines within the first few years, but a *Ribes* canopy is usually sparse and does not strongly suppress pine growth. But, unless pines are planted the very first growing season following disturbance, shrub seedlings such as *Ceanothus* or *Salix* may outcompete the pines (figs. 18, 19).

Shrubs arising from sprouts present a different competitive situation. Sprouting ability of shrubs varies among species and also with size and vigor of the individual. Of the major shrubs in ABGR/ACGL, *Salix* and *Acer* have the greatest sprouting ability. High frequencies of depauperate *Salix* or *Acer* in well-timbered stands can produce a dense layer of vigorous shrubs having broad canopies when the tree canopy is removed. Tree seedlings planted next to these shrub species would be overtopped within 1 to 3 years. Mechanical removal of *Acer* or *Salix* can entail considerable soil displacement because these species develop large stumps and deep

Table 10—Responses of major shrub species to various disturbances

Species	Seed transport; reproduction methods[1]	Maximum heights	Type of disturbance				
			CC, NP	SC, MS	CC, MS	CC, BB	WF
		Feet					
ACGL	Wind; not stored in soil. Germinates on mineral soil in partial shade; stumps resprout.	10 - 12	V	V-s	V	V	V
PHMA	No obvious transport; stored in soil (11 percent viable). Germinates on mineral soil in partial shade. Increases by root sprouts.	3 - 5	V	V-s	V	V	V
VAGL	Birds, mammals; stored in soil (23 percent viable). Germinates on moist mineral soil in partial shade. Increases by shallow rhizomes.	1.5 - 2	v	V-s	v	v	v
RUPA	Birds, mammals; stored in soil (14 percent viable). Increases by rhizomes.	2 - 4	V	V-s	V	V	V
SYAL	Birds, mammals; not stored in soil. Increases by rhizomes.	1 - 1.5	V	v	V	V	V
SPBE	No obvious transport; not stored in soil. Increases by rhizomes.	1 - 2	V	v	V	V	V
ALSI	Wind; not stored in soil. Germinates on moist mineral soil in full sun, stumps resprout.	10 - 13	v	v	v-S	v-s	v-s
SASC	Wind; not stored in soil. Germinates on moist mineral soil in full sun, stumps resprout.	25 - 30	V	v	V-s	V-s	V-s
RIVI & RILA	Birds, mammals, stored in soil (96 percent viable). Germinates on mineral soil in full sun, responds mainly to scarification without burning.	3 - 4	v	v-s	v-S	s	s
CEVE	No obvious transport, stored in soil (91 percent viable). Germinates on mineral soil in full sun, responds mainly to burning and partially to scarification.	5 - 7	v	v	v-s	S	S

DISTURBANCE CODES:
CC, NP = Clearcut, no site preparation
SC, MS = Shelterwood cut, mechanical scarification
CC, MS = Clearcut, mechanical scarification
CC, BB = Clearcut, broadcast burned
WF = Stand-destroying wildfire

RESPONSE CODES:
V = Major vegetative response (coverage increases from existing plants and vigorous sprouting following tree removal but is offset by treatment intensity).
v = Minor vegetative response (coverage increases either from just the existing plants following tree removal or from existing plants and nonvigorous sprouting but is offset by treatment intensity.
S = Major response from seed (coverage increase depends on amount of viable seed available and is enhanced by treatment intensity).
s = Minor response from seed (same criteria as for S).

[1]Stored seed viabilities are from Kramer (1984).

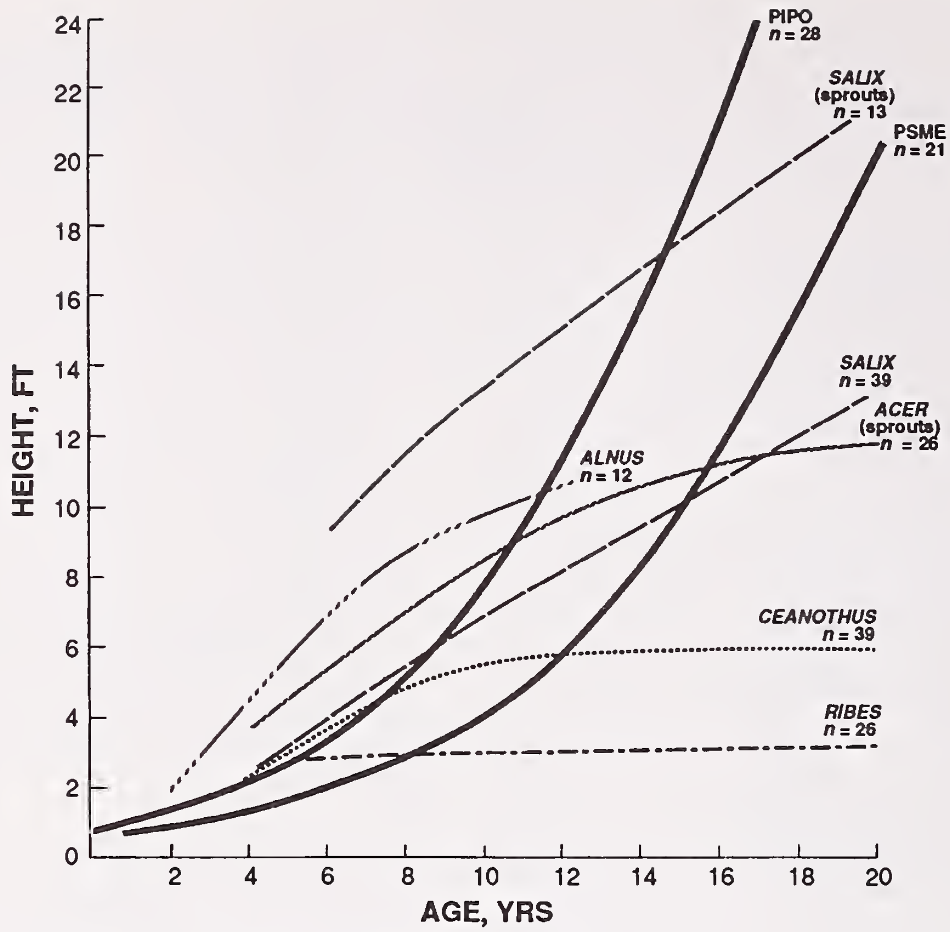


Figure 17—Height-age relationships of free-growing tree seedlings and important shrubs in the ABGR/ACGL h.t.

Figure 18—CEVE-CEVE shrub layer type that resulted from a clearcut and broadcast burn in 1968. *Pinus ponderosa* seedlings were planted the following spring and are now safely above the shrub layer.

Figure 19—CEVE-CEVE shrub layer type that resulted from a clearcut and broadcast burn in 1967. *Pinus ponderosa* seedlings were planted in 1972, four growing seasons later. By that time the shrub layer was well established and easily suppressed the pine plantation.

root systems. Where dense layers of *Salix* or *Acer* occur, managing for *Pseudotsuga* or *Picea* is the only alternative for timber production unless the shrubs can be treated chemically.

Although existing shrub layers in burned or logged-over areas may be difficult to control once high coverages have developed, potential and existing shrub layers in uncut stands can be regulated during silvicultural activities by the kind and intensity of site treatment.

Management considerations may differ among stands having different successional stages within the habitat type, but should include:

1. The desired tree species, its shade tolerance, and growth rate;
2. The kind and intensity of site treatment needed to favor the desired tree species and reduce existing competition;
3. Existing shrub species and their potential for reacting to the proposed timber harvest and site treatment;
4. Potential reactions of buried seed and wind-blown seed to the site treatment selected; and
5. Duration of the potential competition in terms of height-age interactions of shrub species and tree seedlings.

This set of interacting variables may seem complex, but once learned, provides an ecological basis for prescribed treatments on a stand-specific basis.

Natural Tree Establishment and Related Microsites—Naturally established tree seedlings were recorded by species, silvicultural treatment, and microsite conditions. A seedling was defined as a tree less than 4.5 ft (1.4 m) tall and at least 3 years old, but younger than the disturbance.

A total of 561 naturally established *Larix occidentalis*, *Pinus ponderosa*, *Pseudotsuga menziesii*, *Picea engelmannii*, and *Abies grandis* seedlings were recorded for both phases of the ABGR/ACGL h.t. for an average of 631 per acre (1,563 per hectare). *Abies grandis* comprised the largest amount of the regeneration (39 percent) followed by *Pseudotsuga menziesii* (24 percent) and *Picea engelmannii* (19 percent). Most of the *Larix occidentalis* (67 percent) and *Picea engelmannii* (93 percent) were found in the ACGL phase.

A regeneration efficiency (RE) value was computed for each seedling species in each microsite. An RE value of 1.00 indicates that the seedlings occurred in a particular microsite in proportion to the occurrence of that microsite. RE values are designated in five classes as follows: class 1: 0 to 0.25, very inefficient; class 2: 0.26 to 0.75, inefficient; class 3: 0.76 to 1.50, efficient; class 4: 1.51 to 3.00, more efficient; class 5: 3.01 and greater, very efficient. RE values were calculated for each microsite component (seedbed or cover). Other summaries including occurrence of seedlings under various silvicultural methods, site preparation methods, shrub canopy cover, and tree and shrub layer groups are expressed as percentage of occurrence for a species based on the average number of seedlings per treatment.

Although RE values may reflect a relationship between the microsite and tree seedling, several factors affect the interpretation of these values. It was assumed that seedlings persist only in favorable microsites; if a seed germinates in a favorable microsite and the microsite deteriorates, such as through rapid shrub development, the seedling should die. Some seedlings may have been recorded in unfavorable microsites but had not yet perished. Therefore, some microsites identified as beneficial may in fact preclude development of a mature tree. In this respect, the microsite canopy cover is more influential than the seedbed through time, but the relationship between the microsite canopy cover and seedlings was not always easy to determine. In some cases, the tree seedling and canopy cover may have benefited from the same microsite and established near one another coincidentally. In other cases, the tree seedling may have benefited from the existing cover, which provided more favorable microsite conditions in terms of shade, soil moisture and nutrient, humidity, temperature, and wind protection (Zavitkovski and Woodard 1970). Some microsites with cover may favor one seedling species but not another. For example, heavy canopy cover may favor shade-tolerant tree species but not shade-intolerant species, or a certain canopy may be allelopathic to some tree seedlings and not others. Where a positive seedling-microsite relationship exists, the canopy cover species may help establish natural regeneration or indicate favorable microsites. Where a negative relationship exists, canopy cover species may indicate unfavorable microsites.

Larix occidentalis—Most natural regeneration of *Larix occidentalis* was found under group selection cuts (61 percent) followed by seed-tree cuts (33 percent) (table 11); however, the high incidence of *Larix* under group selection cuts was primarily due to one plot. The lack of seedlings following clearcutting or shelterwood cutting is more likely related to a lack of seed rather than the silvicultural method. The group selection cuts and seed-tree cuts with seedlings had seed sources either on the plot or within 100 ft (30 m) of the plot (table 11). *Larix occidentalis* has the lightest seed of all the central Idaho species (Minore 1979) and would probably produce adequate regeneration even in clearcuts if seed were available.

All of the *Larix* seedlings were found on sites that had been scarified and most (80 percent) were found on heavy scarification (table 12). Heavy scarification often removes not only the duff but some of the upper soil horizons as well, and in doing so may reduce the vegetation competition for a longer time compared to light scarification. Light and heavy scarification both promote moss mats, which are very efficient seedbeds for *Larix* (table 13). Other efficient seedbeds are rotten wood and scarified soil.

Larix occidentalis is very shade intolerant, and most *Larix* regeneration was found under light (0 to 33 percent) canopy cover (table 14). Only a small amount occurred under heavy (66 to 100 percent) canopy cover. Sites with *Rubus parviflorus* often produce good natural regeneration (table 15). The group selection plot with the high incidence of *Larix* regeneration had a high coverage of *Rubus*. *Ribes* spp., which often occur following scarification, *Lonicera utahensis*, *Salix scouleriana*, and *Vaccinium globulare* were all very efficient, more efficient, or efficient covers. But although regeneration may occur under these covers, more than one-third of the *Larix* seedlings were found under no cover.

In terms of tree layer groups, the largest amount of seedlings were found in the ABGR tree layer group, mostly because of the one group selection cut, which had a good *Larix* seed source nearby (table 16). For the shrub layer group, most seedlings (89 percent) were found in the RUPA layer group.

Natural regeneration of *Larix* will likely occur under any silvicultural method provided adequate seed sources are present and vegetation competition is reduced. Heavy scarification may reduce vegetation competition and promote moss mats, which are favorable seedbeds. Other good seedbeds are lightly scarified and "churned" seedbeds of loose mineral soil mixed with organics. These seedbeds are often produced by logging activities that loosen and mix soil without scraping it away. *Larix* should regenerate well on sites with *Rubus parviflorus*.

Pinus ponderosa—As with *Larix* the largest amount of *P. ponderosa* seedlings (44 percent) was found in group selection cuts primarily due to one plot in which all conditions were favorable for *P. ponderosa* seedlings (table 11). This particular plot had a seed source within 100 ft (30.5 m) and had

Table 11—Occurrence of natural tree seedlings (percent) by silvicultural method and overstory composition for the ABGR/ACGL h.t., ACGL and PHMA phases

Silvicultural method / Overstory composition	Number of sites	Present tree cover	Average distance to seed source[2]	Average distance to seed source for plots with seedlings	Present basal area[2]	Species, natural seedlings per acre: *L. occidentalis*, 55	*P. ponderosa*, 48	*P. menziesii*, 154	*P. engelmannii*, 108	*A. grandis*, 220
		Percent	Feet	Feet	Feet	Percent	Percent	Percent	Percent	Percent
Clearcut	47				8	4	14	24	5	23
Pinus ponderosa		2	115	89						
Pseudotsuga menziesii		1	107	103						
Picea engelmannii		1	ND	ND						
Abies grandis		2	133	97						
Seed-tree cut	7				62	33	29	26	9	26
Larix occidentalis		1	33	33						
Pinus ponderosa		2	44	[3]0						
Pseudotsuga menziesii		—	80	83						
Picea englemannii		1	ND	ND						
Abies grandis		8	60	43						
Shelterwood cut	13				71	2	13	34	4	40
Larix occidentalis		1	ND	ND						
Pinus ponderosa		1	65	5						
Pseudotsuga menziesii		12	24	20						
Picea englemannii		—	ND	ND						
Abies grandis		15	16	21						
Group selection cut	13				61	61	44	16	82	11
Larix occidentalis		1	[4]70	[4]70						
Pinus ponderosa		1	103	[4]60						
Pseudotsuga menziesii		6	53	31						
Picea englemannii		1	41	43						
Abies grandis		14	27	20						

[1]Percent canopy cover of trees >4 inches d.b.h.
[2]Distance from center of 375 m^2 plot to seed source; immature trees often comprised overstory composition.
[3]Seed source on plot.
[4]Data from only one plot.

Table 12—Occurrence of natural tree seedlings (percent) by site preparation method for the ABGR/ACGL h.t., ACGL and PHMA phases

Tree species	Site preparation method			
	None	Broadcast burn	Scarification Light	Scarification Heavy
Larix occidentalis	—	—	20	80
Pinus ponderosa	28	13	13	46
Pseudotsuga menziesii	33	3	32	32
Picea engelmannii	52	—	18	30
Abies grandis	20	24	33	23
Percent of microplots	18	7	51	24

Table 13—Regeneration efficiency (RE) classes[1] of seedbeds for natural tree seedlings in the ABGR/ACGL h.t., ACGL and PHMA phases

Species	Mineral soil: Scarified and litter-covered	Mineral soil: scarified and bare	Moss mats	Rotten wood	Residual duff	Rocks or stumps
	(*RE*)	(*RE*)	(*RE*)	(*RE*)	(*RE*)	(*RE*)
Larix occidentalis	1	3	5	3	—	—
Pinus ponderosa	3	2	4	3	—	—
Pseudotsuga menziesii	3	3	5	3	4	—
Picea engelmannii	1	3	5	3	—	—
Abies grandis	3	2	4	3	4	—
Seedbed occurrence[2]	64	22	8	2	2	2

[1]RE classes: 1 = 0-0.25, very inefficient; 2 = 0.26-0.75, inefficient; 3 = 0.76-1.50, efficient; 4 = 1.51-3.00, more efficient; 5 = 3.01+, very efficient

[2]Percent occurrence of seedbed in all plots.

Table 14—Occurrence of natural tree seedlings (percent) by shrub canopy cover for the ABGR/ACGL h.t., ACGL and PHMA phases

Species	Shrub canopy cover		
	Light (0-33 percent)	Moderate (33-66 percent)	Heavy (66-100 percent)
Larix occidentalis	75	22	3
Pinus ponderosa	28	12	60
Pseudotsuga menziesii	28	44	28
Picea engelmannii	55	18	27
Abies grandis	33	36	31
Percent of microplots	34	27	39

Table 15—Regeneration efficiency (RE) classes[1] of shrub cover and other microsites for natural tree seedlings in the ABGR/ACGL h.t., ACGL and PHMA phases

Type of cover	Constancy	Area occupied	*Larix occidentalis*	*Pinus ponderosa*	*Pseudotsuga menziesii*	*Picea engelmannii*	*Abies grandis*
	------ *Percent* ------		---------- *Regeneration efficiency* ----------				
None[2]							
Forbs	99.4	20.1	—	1	2	2	2
Grass	89.2	7.4	—	—	—	1	1
Slash	73.9	8.1	—	—	3	1	2
Ribes spp.	71.9	8.0	5	4	3	3	2
Ceanothus velutinus	31.4	10.0	1	3	3	—	3
Salix scouleriana	30.6	7.2	3	2	3	4	3
Rubus parviflorus	28.6	5.2	5	5	4	5	2
Spiraea betulifolia	28.3	2.1	—	5	2	—	2
Lonicera utahensis	26.1	2.5	4	3	4	—	3
Pinus ponderosa	23.9	4.8	—	3	3	—	2
Physocarpus malvaceus	23.9	3.6	—	—	1	2	4
Rosa spp.	23.9	.6	—	5	3	—	3
Vaccinium globulare	21.7	4.5	3	—	4	2	4
Acer glabrum	20.0	3.6	—	—	2	—	4
Pseudotsuga menziesii	12.8	2.0	—	—	2	—	3
Symphoricarpos spp.	11.9	1.3	—	—	3	—	—
Abies grandis	11.1	2.5	—	3	2	—	2
Alnus sinuata	8.9	4.0	—	—	—	5	2
Prunus spp.	6.7	1.4	—	—	3	—	2
Sorbus scopulina	5.8	.9	—	—	—	3	—
Amelanchier alnifolia	5.8	.6	—	—	—	—	—
Sambucus spp.	3.6	.3	—	—	—	5	4
Pachistima myrsinites	3.1	.3	5	—	4	—	—
Picea engelmannii	2.2	.2	—	—	—	—	—
Berberis repens	2.2	.1	—	—	—	—	—
Populus tremuloides	1.9	.8	—	—	—	—	—
Clematis columbiana	1.9	.1	—	—	5	—	—
Shepherdia canadensis	1.4	0	—	—	—	—	—
Artemisia tridentata	1.1	0	—	—	—	—	—
Larix occidentalis	.3	0	—	—	—	—	—

[1]RE classes: 1 = 0-0.25, very inefficient; 2 = 0.26-0.75, inefficient; 3 = 0.76-1.50, efficient; 4 = 1.51-3.00, more efficient; 5 = 3.01+, very efficient

[2]During sampling, no estimate of "none" type of cover was made for each plot; therefore, no RE value could be calculated. But 39 percent of the *Larix occidentalis*, 30 percent of the *Pinus ponderosa*, 15 percent of the *Pseudotsuga menziesii*, and 20 percent of both the *Pinus ponderosa* and *Abies grandis* seedlings were found under no cover.

Table 16—Occurrence of natural tree seedlings (percent) by tree and shrub layer groups in the ABGR/ACGL h.t., ACGL and PHMA phases

	Tree layer group					
Tree seedlings	Depauperate	POTR	PIPO	PSME	PIEN	ABGR
Larix occidentalis	9	—	—	13	—	78
Pinus ponderosa	17	—	47	19	—	17
Pseudotsuga menziesii	14	17	19	38	6	6
Picea engelmannii	1	—	1	—	40	58
Abies grandis	15	—	16	20	26	23
Percent of stands	35	2	28	19	3	13

	Shrub layer group								
	Depauperate	CEVE	RIVI	SASC	ALSI	SPBE	RUPA	LOUT	ACGL/ PHMA
Larix occidentalis	—	3	7	1	—	—	89	—	—
Pinus ponderosa	—	12	—	46	—	—	14	28	—
Pseudotsuga menziesii	12	6	4	16	3	12	19	3	25
Picea engelmannii	—	—	14	1	39	—	46	—	—
Abies grandis	44	10	16	17	7	—	2	2	2
Percent of stands	3	43	16	18	5	3	5	2	5

been heavily scarified, which is a favorable site preparation method for obtaining *P. ponderosa* seedlings (table 12). Seed-tree cuts also produced regeneration; all sampled seed-tree cuts with *P. ponderosa* regeneration had seed sources on the plot and had received light scarification. Overall, scarification accounted for the most seedlings (59 percent). Even though 28 percent of the seedlings were found on sites with no site preparation, no seedlings were found on residual duff (table 13). Moss mats produced by scarification were more efficient seedbeds, while scarified and litter-covered mineral soil and rotten wood are efficient. Most seedlings (60 percent) were found on plots with heavy canopy cover (table 14). Most likely, heavy shade is not a preferred microsite in this habitat type; the seedlings probably germinated and have merely persisted in the heavily shaded microsites. Usually such seedlings grow slowly and many will likely never overtop the shrub canopy. Some vegetation, however, indicates or creates favorable safe sites for *P. ponderosa*. *Rubus parviflorus*, *Spiraea betulifolia*, and *Rosa* spp. are very efficient covers; *Ribes* spp. is more efficient; and *Ceanothus velutinus*, *Lonicera utahensis*, and *Abies grandis* are efficient. *Salix scouleriana* is less efficient.

Almost half of the *P. ponderosa* regeneration was found in the PIPO layer group, primarily due to *P. ponderosa* seed-tree cuts (table 13). For shrub layer groups, almost half of the seedlings were found in the SASC layer group, even though *Salix scouleriana* itself was a less efficient cover for *P. ponderosa*. The LOUT layer group accounted for 28 percent of the seedlings; *Lonicera* is an efficient cover for *P. ponderosa*.

On some sites, seed caches may play an important role in *P. ponderosa* establishment. In the Oregon Cascade Range, West (1968) found that 15 percent of the *P. ponderosa* seedlings resulted from rodent caches. In central Idaho, a similar proportion of rodent-cached *P. ponderosa* (14 percent) was reported by McConkie and Mowat (1936). Medin (1984) indicated that the yellowpine chipmunk (*Eutamias amoenus*) may be responsible for many of the caches found in central Idaho, though Clark's nutcracker (*Nucifraga columbiana*) may also be involved (Giuntoli and Mewaldt 1978; Lanner 1980). In the *Pseudotsuga menziesii/Carex geyeri* h.t., *P. ponderosa* phase, 22 percent of the *P. ponderosa* regeneration apparently established from seed caches (Steele and Geier-Hayes 1987). The occurrence was similar in the *Pseudotsuga menziesii/Spiraea betulifolia* h.t. (16 percent) and *Abies grandis/ Vaccinium globulare* (17 percent). In the ABGR/ ACGL h.t. the occurrence was much the same at 17 percent.

Selection of a silvicultural method for natural regeneration of *Pinus ponderosa* should first address the proximity of *P. ponderosa* seed sources within the stand. *Pinus ponderosa* seed is the heaviest of the central Idaho species (Minore 1979), and most seedlings were found within 100 ft (30 m) of the seed source. Small clearcuts (one-quarter to one-half acre) (0.1 to 0.2 ha) or group selection cuts and seed-tree cuts with heavy to light scarification to promote moss mats should regenerate. *Rubus parviflorus*,

Rosa spp., and *Lonicera* indicate good sites for *P. ponderosa* regeneration.

Pseudotsuga menziesii—Most natural regeneration of *Pseudotsuga* was distributed among shelterwood cuts (34 percent), seed-tree cuts (26 percent), and clearcuts (24 percent) (table 11). Of the *Pseudotsuga* seedlings that occurred under shelterwood cuts, only 20 percent were found in the ACGL phase; 80 percent were in the PHMA phase even though less than half (38 percent) of the sampled shelterwood cuts occurred in the PHMA phase. Shelterwood cuts also were closest to a seed source; however, *Pseudotsuga* seed weighed less than some other central Idaho species and can travel relatively long distances. About one-fourth of the regeneration was found in clearcuts where the average distance to a seed source was 103 ft (31 m).

As with *Larix* and *Pinus ponderosa*, more than half (64 percent) of the *Pseudotsuga* regeneration was found on sites with either light or heavy scarification; however, one-third of the regeneration was found on sites which received no site preparation (table 12). Residual duff is a more efficient seedbed (table 13), and moss mats produced by scarification are very efficient seedbeds. Bare mineral soil, soil that has been scarified and litter-covered, and rotten wood are all efficient seedbeds.

More regeneration (44 percent) was found under moderate (33 to 66 percent) canopy cover than under light or heavy cover (table 14). *Rubus*, *Lonicera*, and *Vaccinium* are more efficient covers while slash, *Ribes*, *Ceanothus*, *Salix*, *Symphoricarpos*, and *Prunus* are all efficient (table 15). *Physocarpus* is very inefficient. For tree layer groups, more regeneration (38 percent) occurred under PSME layer groups than PIPO (19 percent), POTR (17 percent), and depauperate (14 percent) layer groups (table 13). For shrub layer groups, seedlings were distributed throughout the layer groups.

Any silvicultural method will likely regenerate *Pseudotsuga* in this habitat type. The drier, warmer PHMA phase may require more cover or seed to obtain the same amount of regeneration as the ACGL phase, however, clearcuts can be used in both phases to obtain regeneration. Even though residual duff is a more efficient seedbed, most conifers regenerate more reliably on disturbed seedbeds; therefore, light or heavy scarification to promote moss mats are good choices for site preparation. *Pseudotsuga* can regenerate under a wide variety of covers; however, *Physocarpus* is a very inefficient cover and, where coverages are high, may require special treatment to reduce the cover if *Pseudotsuga* regeneration is desired.

Picea engelmannii—Most of the *Picea* regeneration was found at the moist end of the ACGL phase on sites that had been cut using group selection (table 11). About half of the seedlings occurred on scarified sites while the other half were found on sites that had received no site preparation (table 12). *Picea* was not found on residual duff, however, but usually occurred on moss mats (very efficient), scarified and bare mineral soil, and rotten wood (efficient) (table 13). More than half of the seedlings were found under light canopy cover (table 14); on drier sites, however, where *Picea* is less common, more seedlings were found under moderate or heavy shade. *Alnus sinuata* and *Rubus parviflorus* are very efficient covers for *Picea* (table 15). *Salix* is more efficient and *Ribes* is efficient. Almost all of the regeneration was found under the PIEN or ABGR tree layer groups and ALSI and RUPA shrub layer groups (table 16).

Good natural regeneration of *Picea* is restricted to wetter portions of the ACGL phase in the ABGR/ACGL habitat type. Sites that support *Alnus sinuata*, *Ribes lacustre*, and *Actaea rubra* are usually well suited for *Picea* regeneration. Where *Picea* coverages are high, group selection cuts are probably the best choice in order to reduce potential windthrow damage of this shallow-rooted species. Scarification is almost a necessity to produce mineral soil and promote moss mats because these seedbeds are very important for *Picea* regeneration.

Abies grandis—Shelterwood cuts produced the most natural regeneration (40 percent) followed by seed-tree cuts (26 percent) and clearcuts (23 percent) (table 11). Average distance to a seed source increased as occurrence of seedlings decreased except for group selection cuts, which had a fairly short distance to a seed source and the lowest occurrence of seedlings (11 percent). More than half of the regeneration was found on scarified sites (table 12). On broadcast-burned sites *Abies* seedlings were also abundant compared to other seedling species. Lack of site preparation resulted in the least amount of *Abies grandis* regeneration; however, residual duff was rated as a more efficient seedbed (table 13). Moss mats were also more efficient, while rotten wood and scarified and litter-covered mineral soil were only efficient. Seedlings were almost equally distributed under light, moderate, and heavy canopy covers (table 14). *Physocarpus* and *Acer glabrum* were more efficient covers while *Ribes*, *Ceanothus*, *Salix*, *Lonicera*, and *Rosa* were efficient. In terms of tree layer groups, seedlings were common under all the various tree layer groups (table 16). The depauperate shrub layer group had the most seedlings (44 percent), but this was primarily due to the high incidence of *A. grandis* seedlings under a shelterwood cut with a depauperate shrub layer. The SASC, RIVI, and CEVE shrub layer groups supported most of the remaining seedlings (43 percent).

Any silvicultural method will likely produce good natural regeneration of *A. grandis*, particularly shelterwood cutting. Scarification will probably produce the most seedlings and broadcast burning will likely favor *A. grandis* seedlings over other species. *A. grandis* will regenerate under most covers under any amount of shade.

Abies grandis often regenerates in proportion to the amount of *A. grandis* overstory. Overstory cover in the ABGR/ACGL h.t. is usually not necessary to ameliorate site conditions because the habitat type is fairly moist. Therefore *A. grandis* overstories function primarily as a source of seed. Even *Pseudotsuga*, which produced more regeneration under shelterwood cuts in the PHMA phase, should also regenerate successfully within seed-tree cuts and clearcuts. Silvicultural methods that favor overstory or seed sources of the desired species should also reduce overstory or seed sources of *A. grandis* so that proportionately more natural regeneration of the desired species will result.

SUMMARY OF SHRUB LAYER SECTION

The ABGR/ACGL habitat type has a high potential for shrub development. The primary seral shrub species involved are *Ceanothus* and *Ribes* from buried seed, *Salix* and *Alnus* from wind-borne seed, and *Prunus*, *Spiraea*, *Symphoricarpos albus*, and *Rubus parviflorus* from root sprouts or rhizomes. The *Ceanothus* responds mainly to burning while *Ribes* responds to scarification. The *Salix* and *Alnus* establish on soil exposed by any means. The rhizomatous shrubs respond mainly to increased sunlight; they are seldom killed by scarification or burning.

Burning produces dense shrub layers with high forage values for wildlife, low pocket gopher potential, and severe competition for tree seedlings. Scarification results in more open shrub layers having lower values for wildlife, greater pocket gopher potential, and less competition for tree seedlings. Where burning is necessary, shade-intolerant trees (pine or larch) must be planted the following spring so that the shrubs do not outcompete the trees. Where residual shrubs are sparse, no treatment may be the preferred alternative for tree plantations.

Larix can be regenerated in seed-tree cuts that are well scarified. Sites supporting *Rubus parviflorus* should regenerate *Larix* by this method.

Pinus ponderosa can be regenerated within 100 ft (30 m) of seed trees on sites that are well scarified. Sites supporting *Rosa*, *Rubus parviflorus*, or *Spiraea* should regenerate *P. ponderosa*.

Pseudotsuga menziesii will regenerate under a shelterwood on the warmer, drier sites in the PHMA phase and in clearcuts in the remainder of the habitat type. Seed trees should be within 100 ft (30 m) of the seedbed. Scarified soil is the recommended seedbed.

Picea engelmannii will establish on wetter sites of the ACGL phase that support *Actaea rubra* or high coverages (>5%) of *Ribes lacustre* or *Alnus sinuata*. Small group selection cuts having partial shade and bare soil provide the best regeneration opportunities. *Alnus* and *Rubus parviflorus* provide the best microsite cover.

Abies grandis regenerates readily in most situations and attempts to regenerate other timber species will produce large proportions of *A. grandis* whenever the seed is present. Consequently, *A. grandis* seed sources should be reduced when other timber species are a management objective.

The Herb Layer

Succession in the herb layer is more complex than in the tree or shrub layer. Modal conditions of seral stages are evident but more variable because more species are involved. More species imply potentially more herb layer types, but the increase has been less than expected. It is possible that more kinds of disturbance are needed to generate the potentially broad array of layer types. Still, the following herb layer classification appears to follow logical successional patterns even though it may eventually need more refinement than the tree or shrub layer classification.

Table 17 lists the important perennial herb layer species, which were those having greater than 5 percent cover somewhere in the data. Many unlisted species may be present in lesser amounts, and some potentially important species may yet be found. Relative successional amplitudes of important herb layer species (fig. 20) were derived by developing hypotheses for each species followed by testing through many field observations as well as data analysis. Because succession in the herb layer progresses more rapidly than in the tree or shrub layer, successional amplitudes for some herb layer species can also be derived from the permanent plot records of Stickney (1980, 1985). As in the tree and shrub layer, successional amplitudes of herb layer species are meaningful only in a relative sense, and the greatest accuracy lies with those amplitudes that are farthest apart. For instance, species indicating the annuals layer group clearly have less amplitude than *Thalictrum* (fig. 20). But there is less certainty to the relative amplitudes of adjacent taxa such as *Pteridium* versus *Fragaria*.

The relative successional amplitudes in figure 20 provide a basis for the herb layer classification (fig. 21). This classification consists of eight layer groups; the full data set appears in appendix C.

Table 17—Roles of important herb layer species in the ABGR/ACGL h.t.

ADP No.	Herb layer species	Abbreviation	Role[1]
	Perennial graminoids		
303	*Bromus carinatus*	BRCA	ES
282	*Bromus inermis*	BRIN	ES
307	*Calamagrostis rubescens*	CARU	C
309	*Carex geyeri*	CAGE	LS
311	*Carex rossii*	CARO	ES
	Ferns		
259	*Pteridium aquilinum*	PTAQ	(MS)
	Perennial herbs		
403	*Adenocaulon bicolor*	ADBI	C
415	*Apocynum androsaemifolium*	APAN	MS
420	*Arenaria macrophylla*	ARMA	MS
421	*Arnica cordifolia*	ARCO	C
426	*Aster conspicuus*	ASCO	LS
429	*Astragalus canadensis*	ASCA	ES
438	*Castilleja miniata*	CAMI	MS
445	*Circaea alpina*	CIAL	MS
459	*Epilobium angustifolium*	EPAN	(MS)
465	*Fragaria vesca*	FRVE	MS
466	*Fragaria virginiana*	FRVI	(MS)
471	*Galium triflorum*	GATR	C
833	*Iliamna rivularis*	ILRI	ES
636	*Lathyrus nevadensis*	LANE	C
522	*Potentilla glandulosa*	POGL	ES
519	*Polemonium pulcherrimum*	POPU	C
547	*Thalictrum occidentale*	THOC	C
562	*Thermopsis montana*	THMO	MS

[1]ES = early seral; MS = mid-seral; LS = late seral; C = climax; () = occurs in only part of the h.t.

Although the classification is based on 86 sample plots, some layer groups have little data. Data in the annuals layer group are scarce because these conditions often occur within 5 years following disturbance, and recently disturbed sites were not a sampling objective. Other layer types may be found with more reconnaissance, may appear only after uncommon disturbances, or may be rare under any circumstance.

A key to herb layer types (table 18) is easily derived from the classification diagram (fig. 21). This key contains numerous alternate indicator species. Much of this lumping is necessary to maintain a workable number of units in this diverse vegetative layer. In some cases, combining indicator species has reduced uniformity within the unit because the species represent minor differences of environment or successional pattern within the habitat type. In other cases, the alternate indicators are common environmental and successional equivalents, and the classified unit retains substantial uniformity. In all cases the lumped species appear to have similar successional amplitudes (fig. 20).

Early seral annuals, biennials, and short-lived perennials were grouped into one unit because there appears to be no practical reason to recognize them separately. *Astragalus canadensis* and *Carex rossii* were grouped with *Potentilla* because of similar responses to scarification. *Iliamna* was grouped with *Potentilla* because both have seed stored in the soil. *Thermopsis* was grouped with *Castilleja* because both increase slowly and are indicators of mid-seral conditions. *Apocynum* and *Circaea* were grouped with *Pteridium* as aggressive rhizomatous mid-seral indicators. *Carex geyeri* and *Aster conspicuus* were combined as late seral indicators. *Calamagrostis* and *Polemonium* were grouped with *Arnica* as near-climax indicators, and *Lathyrus nevadensis* and *Galium triflorum* were grouped with *Thalictrum* as climax indicators.

ANNUALS LAYER GROUP (ANN. L.G.)

Annuals, mainly species of *Collinsia*, *Epilobium*, *Gayophytum*, *Montia*, and *Polygonum* can develop high coverages on newly exposed soil in full sunlight. These taxa have little competitive ability, and their annual nature makes them vulnerable to replacement by any perennial. Likewise, biennials such as *Lactuca*, *Verbascum*, and *Cirsium vulgare* and the short-lived perennials *Phacelia* and *Gnaphalium* must reestablish frequently in order to maintain high coverages. Without recurring disturbance, these taxa are also easily replaced. Relative amounts of these early seral colonizers vary considerably following disturbance and appear to be mainly a function of available seed rather than the type of disturbance.

Annuals represent the earliest seral conditions of the herb layer and are often replaced within 5 years following disturbance; however, they can be maintained by livestock use. Although not a sampling objective, a few annuals layer types were encountered (fig. 21). These layer types resulted from clearcutting or partial cutting followed by bulldozer scarification. Some cattle use was evident, and pocket gophers were present on all the sites. None of these layer types was more than 6 years old and all were losing their foothold to rapidly developing shrub layers.

BROMUS CARINATUS LAYER GROUP (BRCA L.G.)

Bromus carinatus is a nonrhizomatous grass that has little tolerance for shade and decreases under grazing, mainly from cattle. Occasionally, it develops high coverages in early seral stages either from direct seeding or natural colonization. In both cases, however, the sites receive little or no grazing.

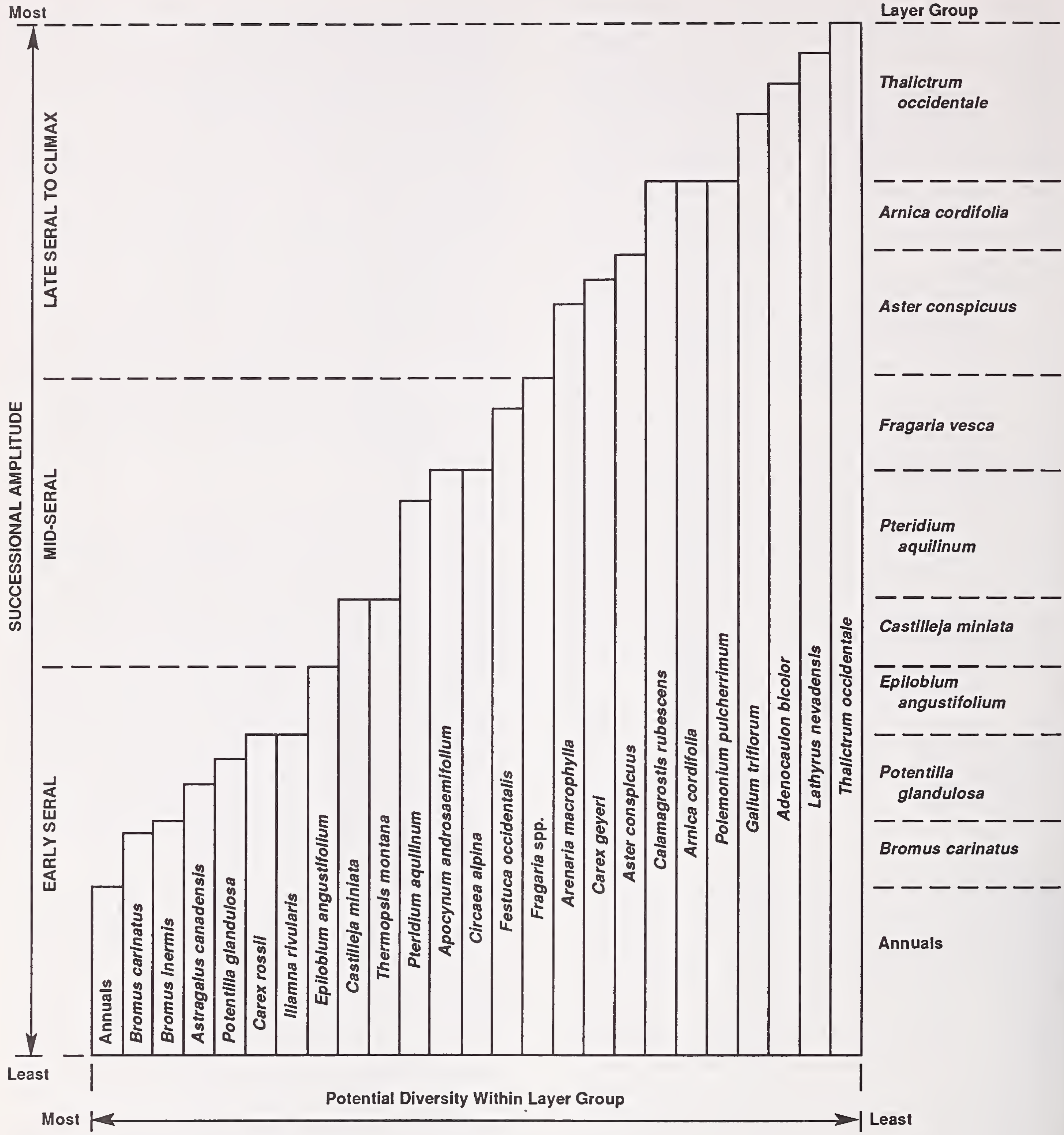


Figure 20—Relative successional amplitudes of important herb layer species in the ABGR/ACGL h.t.

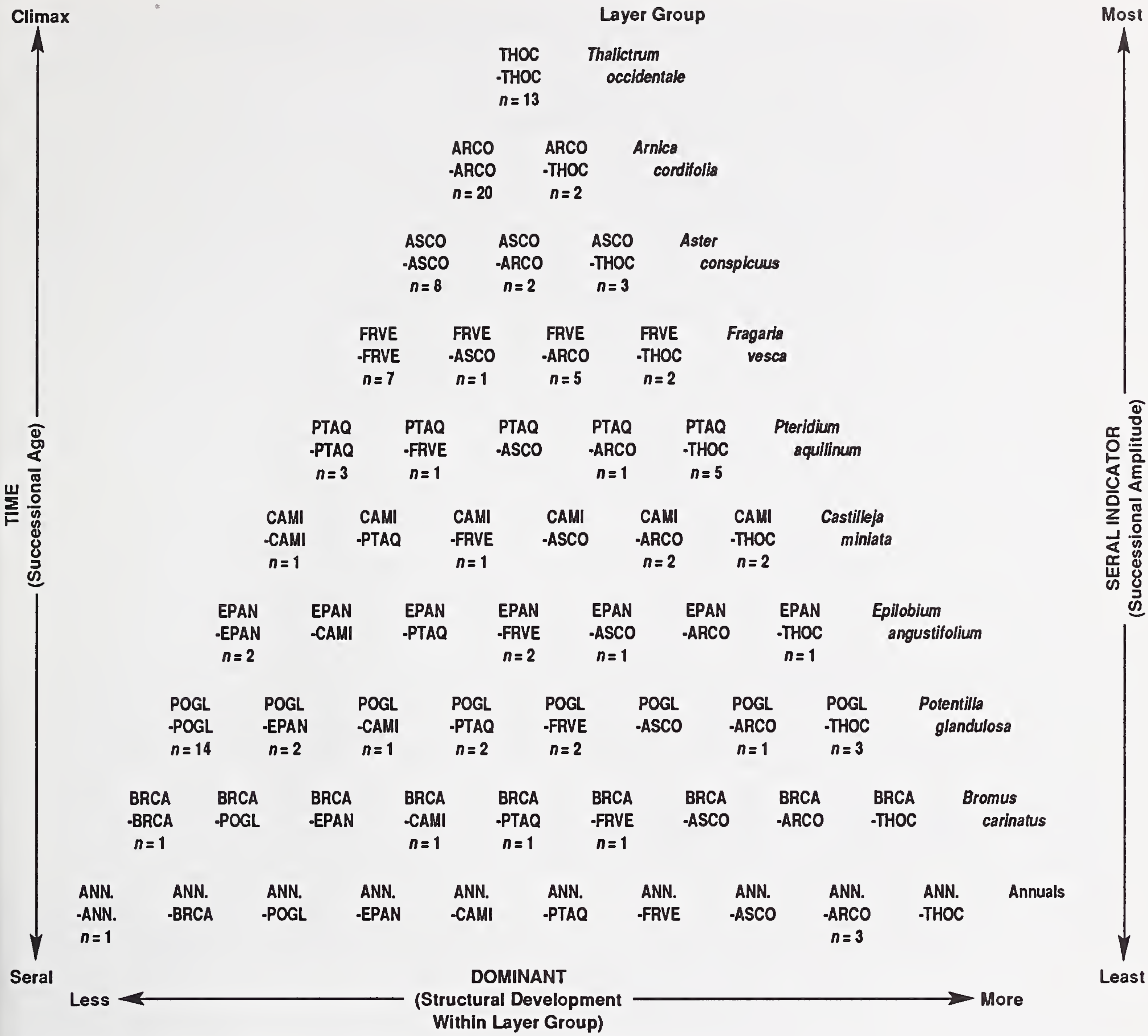


Figure 21—Succession classification diagram of the herb layer in the ABGR/ACGL h.t., both phases (n = number of samples in each layer type).

Table 18—Key to herb layer groups and layer types, with ADP codes, in the ABGR/ACGL h.t.

		ADP codes
1. Annuals, biennials, and short-lived perennials (see layer group description for species) well represented[1] either individually or collectively	ANNUALS LAYER GROUP	900
(Choose first condition that fits)		
1a. The above species dominant	ANN.-ANN. Layer Type	900.900
1b. *Bromus carinatus* (incl. *Bromus inermis*) dominant or codominant	ANN.-BRCA Layer Type	900.303
1c. *Potentilla glandulosa* (incl. *Astragalus canadensis*, *Carex rossii*, and *Iliamna rivularis*) dominant or codominant	ANN.-POGL Layer Type	900.522
1d. *Epilobium angustifolium* dominant or codominant	ANN.-EPAN Layer Type	900.459
1e. *Castilleja miniata* (incl. *Thermopsis montana*) dominant or codominant	ANN.-CAMI Layer Type	900.438
1f. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina)* dominant or codominant	ANN.-PTAQ Layer Type	900.259
1g. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) dominant or codominant	ANN.-FRVE Layer Type	900.465
1h. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	ANN.-ASCO Layer Type	900.426
1i. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	ANN.-ARCO Layer Type	900.421
1j. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	ANN.-THOC Layer Type	900.547
1. Annuals, biennials, and short-lived perennials poorly represented	2	
2. *Bromus carinatus* (incl. *B. inermis*) well represented	BRCA LAYER GROUP	303
2a. The above species dominant	BRCA-BRCA Layer Type	303.303
2b. *Potentilla glandulosa* (incl. *Astragalus canadensis*, *Carex rossii*, and *Iliamna rivularis*) dominant or codomiant	BRCA-POGL Layer Type	303.522
2c. *Epilobium angustifolium* dominant or codominant	BRCA-EPAN Layer Type	303.459
2d. *Castilleja miniata* (incl. *Thermopsis montana*) dominant or codominant	BRCA-CAMI Layer Type	303.438
2e. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) dominant or codominant	BRCA-PTAQ Layer Type	303.259
2f. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) dominant or codominant	BRCA-FRVE Layer Type	303.465
2g. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	BRCA-ASCO Layer Type	303.426
2h. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	BRCA-ARCO Layer Type	303.421
2i. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	BRCA-THOC Layer Type	303.547

(con.)

Table 18 (Con.)

		ADP codes
2. *Bromus carinatus* (incl. *B. inermis*) poorly represented 3		
3. *Potentilla glandulosa* (incl. *Astragalus canadensis, Carex rossii,* and *Iliamna rivularis*) well represented	POGL LAYER GROUP	522
3a. The above species dominant	POGL-POGL Layer Type	522.522
3b. *Epilobium angustifolium* dominant or codominant	POGL-EPAN Layer Type	522.459
3c. *Castilleja miniata* (incl. *Thermopsis montana*) dominant or codominant	POGL-CAMI Layer Type	522.438
3d. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) dominant or codominant	POGL-PTAQ Layer Type	522.259
3e. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) dominant or codominant	POGL-FRVE Layer Type	522.465
3f. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	POGL-ASCO Layer Type	522.426
3g. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	POGL-ARCO Layer Type	522.421
3h. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	POGL-THOC Layer Type	522.547
3. *Potentilla glandulosa* (incl. *Astragalus canadensis, Carex rossii,* and *Iliamna rivularis*) poorly represented 4		
4. *Epilobium angustifolium* well represented	EPAN LAYER GROUP	459
4a. The above species dominant	EPAN-EPAN Layer Type	459.459
4b. *Castilleja miniata* (incl. *Thermopsis montana*) dominant or codominant	EPAN-CAMI Layer Type	459.438
4c. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) dominant or codominant	EPAN-PTAQ Layer Type	459.259
4d. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) dominant or codominant	EPAN-FRVE Layer Type	459.465
4e. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	EPAN-ASCO Layer Type	459.426
4f. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	EPAN-ARCO Layer Type	459.421
4g. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	EPAN-THOC Layer Type	459.547
4. *Epilobium angustifolium* poorly represented 5		
5. *Castilleja miniata* (incl. *Thermopsis montana*) well represented	CAMI LAYER GROUP	438
5a. The above species dominant	CAMI-CAMI Layer Type	438.438
5b. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) dominant or codominant	CAMI-PTAQ Layer Type	438.259
5c. *Fragaria vesca* (incl. *F. virginiana*) dominant or codominant	CAMI-FRVE Layer Type	438.465

(con.)

Table 18 (Con.)

		ADP codes
5d. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	CAMI-ASCO Layer Type	438.426
5e. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	CAMI-ARCO Layer Type	438.421
5f. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	CAMI-THOC Layer Type	438.547
5. *Castilleja miniata* (incl. *Thermopsis montana*) poorly represented	6	
6. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) well represented	PTAQ LAYER GROUP	259
6a. The above species dominant	PTAQ-PTAQ Layer Type	259.259
6b. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) dominant or codominant	PTAQ-FRVE Layer Type	259.465
6c. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	PTAQ-ASCO Layer Type	259.426
6d. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	PTAQ-ARCO Layer Type	259.421
6e. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	PTAQ-THOC Layer Type	259.547
6. *Pteridium aquilinum* (incl. *Apocynum androsaemifolium* and *Circaea alpina*) poorly represented	7	
7. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) well represented	FRVE LAYER GROUP	465
7a. The above species dominant	FRVE-FRVE Layer Type	465.465
7b. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) dominant or codominant	FRVE-ASCO Layer Type	465.426
7c. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	FRVE-ARCO Layer Type	465.421
7d. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	FRVE-THOC Layer Type	465.547
7. *Fragaria vesca* (incl. *F. virginiana* and *Festuca occidentalis*) poorly represented	8	
8. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) well represented	ASCO LAYER GROUP	426
8a. The above species dominant	ASCO-ASCO Layer Type	426.426
8b. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) dominant or codominant	ASCO-ARCO Layer Type	426.421
8c. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	ASCO-THOC Layer Type	426.547

(con.)

Table 18 (Con.)

		ADP codes
8. *Aster conspicuus* (incl. *Carex geyeri* and *Arenaria macrophylla*) poorly represented	9	
9. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) well represented	ARCO LAYER GROUP	421
9a. The above species dominant	ARCO-ARCO Layer Type	421.421
9b. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) dominant or codominant	ARCO-THOC Layer Type	421.547
9. *Arnica cordifolia* (incl. *Calamagrostis rubescens* and *Polemonium pulcherrimum*) poorly represented	10	
10. *Thalictrum occidentale* (incl. *Galium triflorum* and *Lathyrus nevadensis*) well represented	THOC LAYER GROUP	547
10. *Thalictrum* (incl. *Galium* and *Lathyrus*) poorly represented	Depauperate or unclassified layer type	

[1]"Well represented" means canopy coverage ≥5 percent. "Dominant" refers to greatest canopy coverage regardless of height, "codominant" refers to nearly equal canopy coverage. When keying to layer type, choose first condition that fits.

Bromus inermis is a rhizomatous grass that usually results from direct seeding. It too can develop high coverages on ungrazed sites. Like most grasses, these bromes store little or no seed in the soil (Kramer 1984; Strickler and Edgerton 1976). Both species serve as indicators of this layer group.

BRCA layer types are not common in ABGR/ACGL (fig. 21). They could appear, however, on any site that was severely disturbed and seeded to bromes. Although a mixture of grass species is normally used, only *Bromus carinatus* and *B. inermis* persist on ABGR/ACGL sites. *Bromus inermis* is especially persistent due to its rhizomatous habit and often dominates the site to the extent that natural tree seedlings rarely establish and planted seedlings show poor survival and growth. Consequently, seeding of rhizomatous grasses should be confined to areas where trees are not a management objective. If substantial coverages of *Calamagrostis rubescens* (a rhizomatous native grass) exist prior to disturbance, the seeding of grasses to stabilize soil should not be necessary (Crane and others 1983).

POTENTILLA GLANDULOSA LAYER GROUP (POGL L.G.)

The perennial forb, *Potentilla glandulosa* is nonrhizomatous and intolerant of shade. In full sunlight, this species flowers readily and produces large numbers of seed that store in the soil (Kramer 1984). The seeds often germinate profusely following scarification, which can result from either mechanical treatment of the site or heavy livestock use. *Potentilla* seems to be less palatable to livestock than most associated herbs and can increase under grazing to the point of being the only species that is well represented on the site.

Astragalus canadensis is a shade-intolerant rhizomatous forb with seed that can store in the soil (Kramer 1984). The seed sprouts readily in clearcuts following burning or scarification. *Astragalus canadensis* was found only occasionally in ABGR/ACGL but when found, was usually well represented in clearcut areas. It appears to be a successional equivalent of *Potentilla* and is included as an alternate indicator of this layer group.

Carex rossii is a nonrhizomatous sedge that stores its seed in the soil or duff (Kramer 1984). The seed germinates readily following scarification but responds poorly to burning. On thoroughly scarified sites, *Carex rossii* can dominate the herb layer and remain well represented until replaced by taller species. In spring, it provides some forage for large herbivores. In ABGR/ACGL, *Carex rossii* often associates with *Potentilla*, but the *Potentilla* tends to be more common. High coverages of *C. rossii* occur only in the cooler extremes of the ABGR/ACGL h.t. This *Carex* appears to be a successional equivalent of *Potentilla*.

Iliamna rivularis is a nonrhizomatous early seral perennial. In full sun it can flower profusely and

produce seeds that store in the soil for long periods (Kramer 1984). This species can become well represented following high-intensity wildfire or clearcutting and intense broadcast burning, particularly where slash has been piled and burned. It may also appear following scarification but is seldom well represented. This response is common in other habitat types such as Douglas-fir/mountain maple and Douglas-fir/elksedge but is rare in ABGR/ACGL.

POGL layer types are common in ABGR/ACGL (fig. 21). Most were disturbed 3 to 25 years ago (appendix C), and the more persistent ones were receiving heavy livestock use. These layer types represent early seral conditions and result mainly from scarification without burning. The POGL-POGL layer type generally results from thorough scarification such as bulldozer-piling operations and often supports high gopher populations. Development of the other POGL layer types depends on the predisturbance herb layer and intensity of scarification. For instance, if *Pteridium* is the only species well represented prior to disturbance and the site is lightly scarified, a POGL-PTAQ layer type will likely result. These layer types can only persist until a shrub or tree layer begins to shade the site. Generally, POGL layer types progress toward CAMI or FRVE layer types, which have less appeal to pocket gophers and higher values for other wildlife.

EPILOBIUM ANGUSTIFOLIUM LAYER GROUP (EPAN L.G.)

Epilobium angustifolium is a rhizomatous perennial that can establish readily from windblown seed. In open areas created by stand-destroying wildfire, it characteristically colonizes bare soil and forms extensive colonies that bloom profusely (Stickney 1985). *Epilobium*, however, does not always need burned areas for establishment. In clearcuts, it often appears on burned or unburned bulldozer-piled debris, where soil and debris have been mixed. Apparently the required substrate for *Epilobium* is deep, loose soil, usually exposed by either fire or logging. Besides providing esthetic color to the landscape, *Epilobium* is highly palatable to deer, elk, and sheep and is a major nectar source for hummingbirds. It is most productive in full sun but can persist in a depauperate condition beneath partial shade.

EPAN layer types are common in ABGR/ACGL; four of the seven possible layer types were found (fig. 21). These layer types usually reflect disturbances created by wildfire or broadcast burning. On several sites, EPAN layer types appeared to have established from past wildfire and were rejuvenated by clearcutting or partial cutting without burning.

CASTILLEJA MINIATA LAYER GROUP (CAMI L.G.)

Castilleja miniata is a woody-based forb with some tolerance for light shade and grazing. It occasionally develops relatively high coverages in lightly grazed stands of patchy timber or scattered tall shrubs but is most common on ungrazed sites that have been clearcut and well scarified. *Castilleja applegatei* strongly resembles *C. miniata* and may also be present on some of these sites, especially in the Weiser River drainage. Both species are considered as successional equivalents.

Thermopsis montana is a rhizomatous forb with seeds that can store in the forest soil (Kramer 1984). Its tolerance for shade and grazing appears similar to that of *C. miniata*, and it occurs in similar site conditions. For these reasons, it was included in the CAMI l.g.

Conceptually, the CAMI layer group represents either the mid-seral stages of a scarified but ungrazed clearcut or, more likely, the successional advance of early seral POGL layer types, which usually have been grazed. Most CAMI layer types have been observed progressing toward APAN, CAGE, and CARU layer groups as the amount of shade or competition increases. The CAMI layer group contains six possible layer types, four of which have been found (fig. 21). The layer types occurred mainly in clearcut areas that had been scarified 8 to 22 years ago. A few sites had also been burned.

PTERIDIUM AQUILINUM LAYER GROUP (PTAQ L.G.)

Pteridium is an aggressive rhizomatous fern capable of developing extensive colonies, especially with repeated burning. It can dominate the herb layer of forest openings for many decades, even without burning, and often maintains relatively pure stands. This latter trait has implicated *Pteridium* with allelopathic capability, a feature substantiated by Stewart (1975), Horsley (1977), and del Moral and Cates (1971). Apparently the senescent fronds produce the greatest inhibitory effects on certain herbaceous and woody vegetation. Recently, Ferguson and Boyd (1988) showed that *Pteridium* substantially inhibits conifer seedlings, which helps explain why *Pteridium* patches can persist in forest openings. *Pteridium* grows vigorously in full sun and can even increase in partial shade but declines under a mature *Abies grandis* canopy. For this reason, *Pteridium* represents a mid-seral stage of herb layer succession.

Circaea alpina is a rhizomatous forb that can form large patches beneath a partial tree canopy. In ABGR/ACGL, it occurs mainly in the wetter portions

of the ACGL phase where some form of scarification has occurred. It is perhaps most common in partially logged stands of *Picea* and is rare in large clearcuts. *Circaea* seed apparently does not store in the soil (Kramer 1984), but the rhizomatous nature of the plant provides for rapid increase once established. Like *Pteridium*, *Circaea* declines beneath a climax tree canopy and thus represents a mid-seral stage of herb layer succession. *Circaea* occurred infrequently in ABGR/ACGL and was included in the PTAQ layer group as the most similar successional condition.

Apocynum androsaemifolium is a rhizomatous forb that can develop substantial coverage in full sun or partial shade. It is unpalatable to livestock and can withstand light to moderate grazing impacts. Apparently its seed does not store in the soil (Kramer 1984). *Apocynum* rarely develops high coverages in ABGR/ACGL and was well represented in only one stand. It appears to occupy a successional role most similar to *Pteridium* and was included in the PTAQ layer group.

PTAQ layer types are common in ABGR/ACGL but occur mostly in the ACGL phase (fig. 21). They were found mainly on sites that had been partially logged and scarified 7 to 22 years ago; a few sites had experienced wildfire 50 to 80 years ago. Usually either *Rubus parviflorus* or *Alnus sinuata* was the dominant shrub, and some gopher activity was evident. Although it is not known how to eliminate *Pteridium* layer types, it is apparent that clearcutting or even partial cutting will rejuvenate them.

FRAGARIA VESCA LAYER GROUP (FRVE L.G.)

Fragaria vesca and *F. virginiana* can develop substantial coverages through their stoloniferous growth habit. High coverages occur most often beneath a light canopy of trees or tall shrubs where partial shade has reduced competition from early seral herb layers. In clearcut areas that have developed a shrub layer, *Fragaria* often displays high coverages beneath the canopies of large shrubs. The shrub interspaces support species indicative of more recent disturbance and full sunlight such as *Potentilla* and *Castilleja*. *Fragaria virginiana* is uncommon in ABGR/ACGL but occurs occasionally on toeslopes and cooler portions of the habitat type. It is treated as a successional equivalent of *F. vesca* on these cooler sites. Small amounts of *Fragaria vesca* seed will remain viable in the soil (Kramer 1984), but most of the seed is likely dispersed by birds and mammals. Apparently the seedlings require bare, shaded soil for establishment. *Fragaria* is moderately palatable to deer, elk, and sheep. Its leaves remain green through the winter and provide a higher forage value than most herb layer species during that season. The fruits ripen in midsummer and are sought by black bear, grouse, and various songbirds.

Festuca occidentalis is a moderately shade-tolerant nonrhizomatous grass that occasionally becomes well represented in ABGR/ACGL. It does not store seed in the soil but apparently germinates well on bare shaded soil. Because of its infrequent occurrence, *Festuca occidentalis* was arbitrarily grouped with *Fragaria* as an alternate indicator of mid-seral herb layers.

FRVE layer types are common in ABGR/ACGL; all four of the possible layer types were found (fig. 21). Most of these sites had been clearcut or partially logged 8 to 22 years ago; a few had experienced a wildfire 48 to 100 years ago. All of the sites had been scarified or burned. Thus it appears that FRVE layer types do not result from a particular disturbance but are simply a mid-seral stage of herb layer succession following various disturbances. It is not likely that FRVE layer types can be created directly from site treatment, but they could be maintained through repeated partial cutting.

ASTER CONSPICUUS LAYER GROUP (ASCO L.G.)

Aster conspicuus is a moderately shade-tolerant forb that can maintain extensive colonies beneath *Pinus ponderosa* and *Pseudotsuga*. It can increase vegetatively by rhizomes and develop high coverages when the tree canopy is reduced. It also increases following creeping ground fire and is one of the first species to resprout following a stand-destroying fire. Its windblown seed provides long-distance dispersal and probably germinates on bare soil. In this manner, small amounts of *Aster* can establish following stand-destroying wildfire or clearcutting with scarification. ASCO layer types can then evolve under successional conditions that favor vegetative increase of *Aster*.

Carex geyeri is a moderately shade-tolerant sedge found in many habitat types. It tends to grow in a clumped form, especially on dry granitic substrates, but also develops a loose rhizomatous form on wetter sites. Its extensive root system is an effective soil stabilizer even on steep granitic slopes. It has some ability to store seed in the soil (Kramer 1984). The stored seed apparently germinates following wildfire and following clearcutting and scarification. In spring, *C. geyeri* is one of the first plants to produce new growth. This forage has considerable value for elk and bear (appendix C). *Carex geyeri* generally persists in older stands but with increasing shade gives way to its common associates, *Calamagrostis*

rubescens, Arnica, or *Thalictrum*. For this reason, *C. geyeri* represents late seral stages of ABGR/ACGL succession, similar to those of *Aster conspicuus*.

Arenaria macrophylla is a small rhizomatous herb that occasionally develops high coverages beneath a tree or shrub canopy. It has some ability to store viable seed in the soil (Kramer 1984) and apparently responds best to low-intensity burning or light scarification. It was well represented in only one stand and is grouped with *Aster* as a late seral indicator.

The ASCO layer group consists of three layer types, all of which were sampled (fig. 21). All 10 of the sampled stands experienced total or partial loss of tree canopy through logging 7 to 34 years ago or through wildfire 50 to 70 years ago. At least six of these stands also received scarification. In several cases, the ASCO layer type appears to have evolved successionally from EPAN or FRVE layer types, which developed following clearcutting. In other cases it may have developed directly from partial cutting or wildfire. Livestock seldom use these sites (due to dense shrub layers), but evidence of deer, elk, and black bear use was found.

ARNICA CORDIFOLIA LAYER GROUP (ARCO L.G.)

Arnica cordifolia is a shade-tolerant rhizomatous forb that can develop substantial coverages in clearcuts or open stands of timber. On most ABGR/ACGL sites, however, *Arnica* displays low coverages beneath a shrub or tree canopy and so was grouped with *Thalictrum* as a near-climax indicator. Although it persists in moderate shade more successfully than most other herb layer species, *Arnica* shows little ability to increase from seed following any type of disturbance. Like most wind-dispersed species, *Arnica* does not store its seed in the soil (Kramer 1984). *Arnica* increases most effectively from residual plants following partial cutting without scarification or from low-intensity underburns. *Arnica* has moderate forage value for deer, elk, and sheep (appendix C).

Calamagrostis rubescens is a rhizomatous grass that can maintain high coverages under moderate shade as well as in openings. If well established, it can easily survive the impacts of clearcutting and broadcast burning. With increased sunlight, *Calamagrostis* can renew its vigor and easily dominate the herb layer. The resulting sod presents severe competition for tree seedlings and requires either chemical or mechanical treatment for adequate tree seedling survival. The spring-summer forage value of *Calamagrostis* is considered high for black bear, cattle, and elk (appendix C).

Polemonium pulcherrimum (var. *calycinum*) is thought to be a shade-tolerant forb. It is not rhizomatous but can increase from a spreading root system and occasionally develops high coverages. It apparently has limited ability to store seed in the soil (Kramer 1984) and has moderate forage value for deer, elk, and sheep (appendix C). Although *Polemonium* is treated as an alternate successional indicator of the ARCO l.g., its successional amplitude is poorly understood.

There are two ARCO layer types in ABGR/ACGL, and both were found (fig. 21). ARCO-ARCO is the most common layer type in ABGR/ACGL. In most cases, it appears to have evolved from succession following a wildfire 41 to 110 years ago. A few stands were disturbed more recently from either fire or logging. The ARCO-THOC layer type is much less common but may occur in old-growth stands or partially logged areas that received little soil disturbance. These layer types may reflect climax conditions in drier portions of ABGR/ACGL or may be gradually replaced by the THOC layer group.

THALICTRUM OCCIDENTALE LAYER GROUP (THOC L.G.)

Thalictrum occidentale is a shade-tolerant rhizomatous forb that can produce high coverages in old-growth stands. No other species in the herb layer appears capable of replacing *Thalictrum* without the aid of disturbance. The *Thalictrum* coverage can be reduced by moderate scarification, burning, and in some cases, just removal of the tree canopy. *Thalictrum* does not appear capable of storing its seed in the soil (Kramer 1984).

Adenocaulon bicolor is a fibrous-rooted, shade-tolerant forb that can persist in dense shade. It has a sticky seed that is disseminated by animals and does not store in the soil (Kramer 1984). Occasionally *Adenocaulon* becomes well represented where all other forbs are sparse and so is treated as an alternate successional indicator of *Thalictrum*.

Galium triflorum is a weakly rhizomatous shade-tolerant forb that occasionally develops high coverages on well shaded sites. It has a clinging seed that is likely transported by animals but has little ability to store in the soil (Kramer 1984). It has moderate forage value for black bear in spring and for sheep in summer (appendix C). Its ability to persist in old-growth stands denotes *Galium* as a successional equivalent of *Thalictrum*.

Lathyrus nevadensis is a shade-tolerant rhizomatous forb that occurs occasionally in ABGR/ACGL. It can develop high coverages in dense shade and acts as a climax dominant forb in several habitat types. Sheep and cattle find it highly palatable (appendix C). Although *Lathyrus* can store seed in the soil (Kramer 1984), it appears to be a successional equivalent of *Thalictrum* and so is included in this layer group.

In ABGR/ACGL, the THOC layer type occurs throughout most of the habitat type but may be absent on the dry extremes. In these cases, the ARCO-ARCO layer type would be the successional endpoint. Being climax, THOC-THOC can only be attained through successional advance and was found mainly on sites that had not been disturbed for 50 to 100 years. It may also remain intact following low-intensity surface fires that do not destroy the *Thalictrum* rhizomes. The sampled stands contained virtually no sign of livestock use, although occasional deer or elk use, probably for shelter, was evident.

MANAGEMENT IMPLICATIONS

Management implications of the herbaceous layer focus on relative forage values to big game and livestock. A relative index to forage preferences by herb layer type was developed by the same method used for the shrub layer. The palatability ratings given for each species in appendix C were multiplied by the percentage constancy and average canopy cover shown for that species in a given layer type. This step was repeated for all species in that layer type, and the results were summed to give a relative forage index, which was then reduced to index classes (table 19, 20). Range and wildlife managers who have better palatability ratings for a local area can easily recalculate the forage preference indexes from appendix C. Users of tables 19 and 20 should consider the often small sample size of some layer types and possible revision of index values with increased sampling. As more data become available, these forage preference indexes can provide general guidelines to grazing potential for specific management objectives. When both herb and shrub layer types are known for a given site, the index values assigned in tables 19 and 20 can be added to those in tables 8 and 9 to give a total forage index for that site.

Deer—In summer, herb layer forage values for deer are mostly low throughout ABGR/ACGL succession (tables 19, 20). Occasionally, moderate values are found in the POGL, EPAN, and FRVE layer groups. The highest value occurred in the ARCO-THOC layer type (table 19) but this was due to an exceptionally high cover of *Thalictrum* in a single stand and is not likely to be typical of the type.

In winter, forage values are low to nil, which may be irrelevant because ABGR/ACGL sites accumulate deep snowpacks and are seldom accessible to deer during that season.

Elk—Summer forage values for elk are low to moderate. The EPAN-THOC layer type (table 20) had one of the highest values due to the high palatability of both *Epilobium* and *Thalictrum* (appendix C). Partial cutting with low-intensity underburns could maintain this herb layer type. Clearcutting and intense broadcast burning could produce ample *Epilobium* (EPAN-EPAN layer type) for elk forage during the summer.

Winter forage values are low to nil, but there is not likely to be much forage demand in winter due to the deep snowpacks and northerly aspects.

Cattle—Forage values for cattle are mostly low in ABGR/ACGL (tables 19, 20). One exception is a moderate forage value in the FRVE-ARCO layer type (table 19). This is due to a high coverage of *Calamagrostis* in the sampled stands (appendix C).

Sheep—Forage values for sheep are low to moderate. The higher values are scattered throughout herb layer succession from the POGL to the ARCO layer group (tables 19, 20). In most cases the high forage values for sheep correspond to layer types having higher values for deer or elk. This suggests that some competition for the forage resource exists between sheep, deer, and elk.

Black Bear—Forage values for black bear are low to mostly nil in all stages of herb layer succession (tables 19, 20). Individual taxa having high forage values include *Calamagrostis*, *Carex*, *Disporum*, *Fragaria*, *Osmorhiza*, *Smilacina*, and *Thermopsis*. Of these, only *Calamagrostis*, *Carex*, and *Fragaria* tend to become well represented in ABGR/ACGL.

Pocket Gophers—In contrast to much drier habitat types (Steele and Geier-Hayes 1986, 1987), gopher activity is generally quite low in ABGR/ACGL. But field observations indicate that frequent disturbances in a stand such as from repeated partial cutting can lead to a minor gopher population. When these partial cuttings are followed by a clearcut and scarification, high gopher populations can result. Some relationships between pocket gopher occurrence and silvicultural activities were previously discussed (see Tree Layer section). Scarification without burning resulted in the most gopher activity (figs. 9, 10). In general, scarification produces early seral herb layers, which are mainly ANN., BRCA, or POGL herb layer types. Apparently herb layers in these groups stimulate gopher populations. The scarification can result from either machinery or heavy livestock use and may account for the observed correlation between heavy grazing and high gopher activity in other areas (Buechner 1942). The relationship between gopher activity and early seral herb layers created by scarification without burning was also found in other habitat types (Steele and Geier-Hayes 1986, 1987). Other types of disturbance, such as broadcast burning, generally result in either a depauperate or more successionally advanced herb layer type and often result in less gopher activity.

Table 19—Relative index classes to big-game and livestock forage preferences by herb layer type in ABGR/ACGL h.t., ACGL phase[1]

Layer group Layer type	No. of stands	Deer SU[2]	Deer W	Elk SU	Elk W	Cattle SU	Sheep SU	Black bear SP	Black bear SU	Black bear F
Annuals										
ANN.-ANN.	1	[3]1	0	1	0	1	1	0	0	0
ANN.-ARCO	2	1	0	1	0	1	1	0	0	0
Bromus carinatus										
BRCA-CAMI	1	1	1	2	1	2	1	0	0	0
BRCA-PTAQ	1	2	1	2	1	2	2	0	1	0
Potentilla glandulosa										
POGL-POGL	9	1	1	2	1	1	2	0	0	0
POGL-EPAN	1	2	2	3	2	2	3	0	1	0
POGL-CAMI	1	1	1	1	1	1	1	0	0	0
POGL-PTAQ	1	1	1	1	1	1	1	0	0	0
POGL-ARCO	1	2	0	2	0	1	2	0	0	0
POGL-THOC	3	2	1	2	1	1	2	0	0	0
Epilobium angustifolium										
EPAN-EPAN	2	3	1	4	1	2	3	0	0	0
EPAN-FRVE	1	2	2	3	2	2	2	1	2	1
EPAN-ASCO	1	2	1	3	1	2	2	0	0	0
Castilleja miniata										
CAMI-THOC	2	1	0	2	0	1	1	0	0	0
Pteridium aquilinum										
PTAQ-PTAQ	3	1	0	1	0	1	1	0	0	0
PTAQ-ARCO	1	1	0	1	0	1	1	0	0	0
PTAQ-THOC	4	1	0	1	0	1	1	0	0	0
Fragaria vesca										
FRVE-FRVE	1	1	1	1	1	1	1	0	1	0
FRVE-ARCO	3	3	2	4	2	4	4	2	2	1
FRVE-THOC	1	2	1	2	1	1	2	1	1	0
Aster conspicuus										
ASCO-ASCO	4	1	0	1	1	1	1	0	0	0
ASCO-THOC	1	2	1	3	2	2	2	1	1	0
Arnica cordifolia										
ARCO-ARCO	8	1	0	1	0	1	1	0	0	0
ARCO-THOC	1	4	1	5	1	2	4	1	0	0
Thalictrum occidentale										
THOC-THOC	9	1	1	2	1	1	1	0	0	0

[1]Based on palatability ratings by Kufeld and others (1973), USDA FS (1986), and Beecham (1981).
[2]SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).
[3]Code to index classes:

0 = 0-50	1 = 51-150	2 = 151-250 (low)
3 = 251-350	4 = 351-450	5 = 451-550 (moderate)
6 = 551-650	7 = 651-750	8 = 751-850 (high)

Table 20—Relative index classes to big-game and livestock forage preferences by herb layer type in ABGR/ACGL h.t., PHMA phase[1]

Layer group / Layer type	No. of stands	Deer SU[2]	Deer W	Elk SU	Elk W	Cattle SU	Sheep SU	Black bear SP	Black bear SU	Black bear F
Annuals										
ANN.-ARCO	1	[3]1	1	2	1	2	2	1	1	0
Bromus carinatus										
BRCA-BRCA	1	1	1	1	1	1	1	0	0	0
BRCA-FRVE	1	2	1	2	2	2	2	0	0	0
Potentilla glandulosa										
POGL-POGL	5	1	1	2	1	1	2	0	0	0
POGL-EPAN	1	3	2	4	2	2	3	1	1	0
POGL-PTAQ	1	3	1	2	1	2	3	0	0	0
POGL-FRVE	2	2	1	2	1	1	2	2	2	1
Epilobium angustifolium										
EPAN-FRVE	1	2	1	2	1	1	2	1	1	0
EPAN-THOC	1	3	2	5	2	2	3	0	0	0
Castilleja miniata										
CAMI-CAMI	1	1	1	1	1	1	1	1	0	0
CAMI-FRVE	1	1	1	1	1	1	1	1	1	0
CAMI-ARCO	2	1	1	2	1	2	2	2	1	1
Pteridium aquilinum										
PTAQ-FRVE	1	1	1	1	1	1	1	1	1	0
PTAQ-THOC	1	2	1	2	1	2	3	1	1	0
Fragaria vesca										
FRVE-FRVE	6	1	1	1	1	1	1	1	1	1
FRVE-ASCO	1	1	1	1	1	1	2	1	1	0
FRVE-ARCO	2	2	1	2	1	2	2	1	1	1
FRVE-THOC	1	2	1	2	1	1	2	0	1	0
Aster conspicuus										
ASCO-ASCO	4	1	1	1	1	1	1	1	0	0
ASCO-ARCO	2	2	1	3	2	2	2	2	1	1
ASCO-THOC	2	2	1	3	1	2	3	1	0	0
Arnica cordifolia										
ARCO-ARCO	12	1	1	2	1	2	2	1	1	0
ARCO-THOC	1	2	1	2	1	2	2	0	0	0
Thalictrum occidentale										
THOC-THOC	4	1	0	1	0	0	1	0	0	0

[1]Based on palatability ratings by Kufeld and others (1973), USDA FS (1986), and Beecham (1981).
[2]SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).
[3]Code to index classes: 0 = 0-50; 1 = 51-150; 2 = 151-250 (low); 3 = 251-350; 4 = 351-450; 5 = 451-550 (moderate); 6 = 551-650; 7 = 651-750; 8 = 751-850 (high)

In summarizing studies of pocket gophers, Teipner and others (1983) suggest that plant species composition and abundance are the main regulators of gopher density. More specifically, Anderson and MacMahon (1981) correlated gopher population decline in a spruce-fir forest with decreasing palatable vegetation due to advancing successional stages. Herb layer succession in certain habitat types (Steele and Geier-Hayes 1987, 1989) has shown a similar relationship. In ABGR/ACGL, there also appears to be a higher concentration of gopher activity in the early seral BRCA and POGL layer groups than in the more successionally advanced herb layers (fig. 22). These layer types are usually the result of severe disturbance such as machine scarification. The BRCA layer group can also result from direct seeding on severely burned areas.

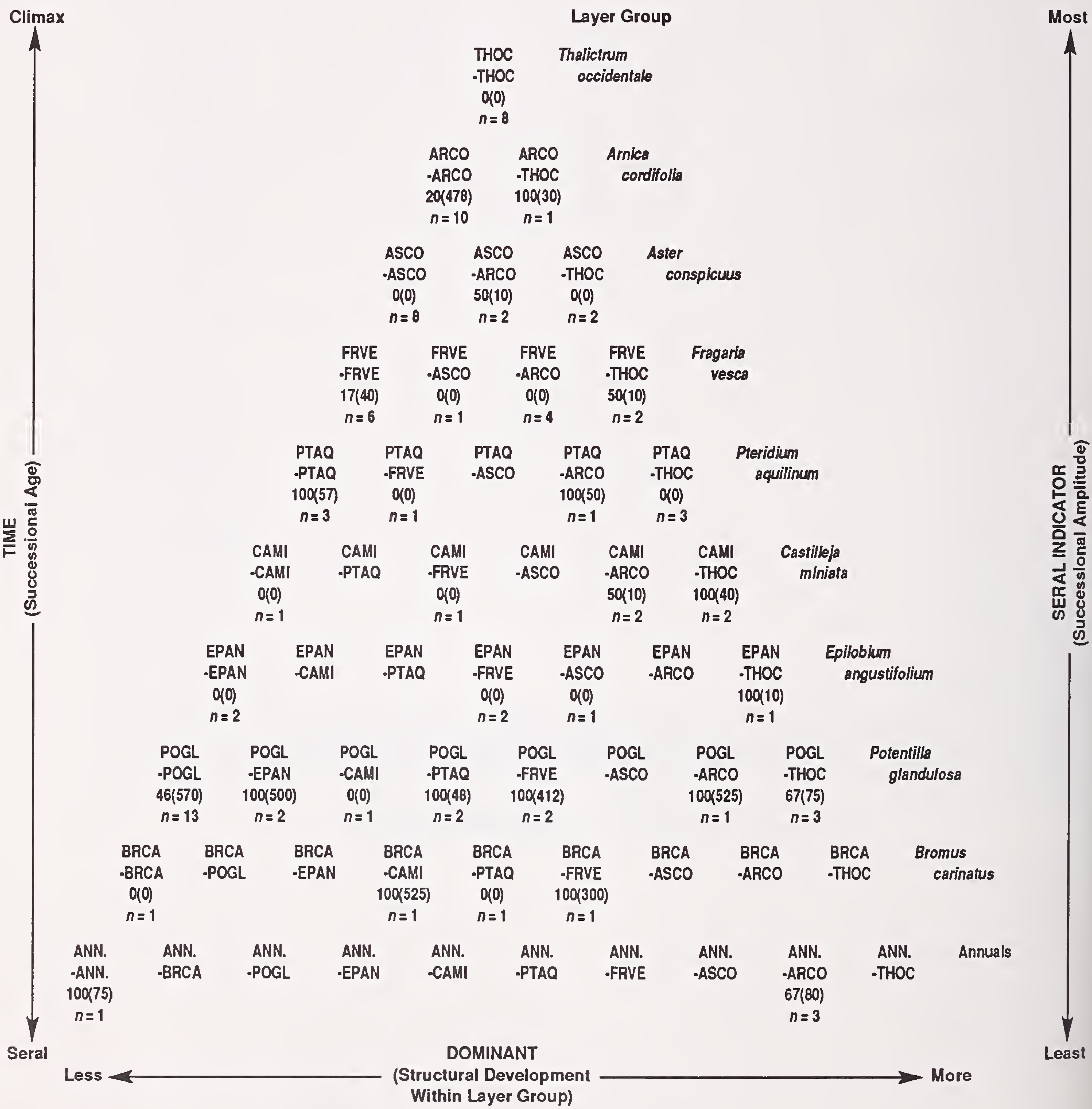


Figure 22—Constancy and average number per acre of pocket gopher mounds in various herb layer types (n = number of samples in each layer type).

SUMMARY OF HERB LAYER SECTION

Early seral conditions in the herb layer are characterized by annuals, *Bromus*, *Potentilla*, *Astragalus*, *Iliamna*, *Carex rossii*, and *Epilobium angustifolium*. These taxa result from either thorough scarification or intense burning.

Mid-seral taxa include *Castilleja*, *Thermopsis*, *Pteridium*, *Apocynum*, *Circaea*, *Fragaria*, and *Festuca occidentalis*. They usually become important as the early seral species decline. Occasionally they result from moderate scarification or burning in partial shade.

Late-seral to climax species include *Carex geyeri*, *Aster conspicuus*, *Calamagrostis rubescens*, *Arnica cordifolia*, *Polemonium pulcherrimum*, *Galium triflorum*, *Adenocaulon bicolor*, *Lathyrus nevadensis*, and *Thalictrum occidentale*. These species persist in undisturbed stands and often maintain high coverages there. Some are easily reduced by severe disturbances, while others may increase their coverages when shade is reduced.

The EPAN and FRVE herb layer types produce moderate forage values for deer, elk, and sheep. These layer types usually result from burning. Forage values for cattle and black bear are low throughout the herb layer succession.

Pocket gophers occur mainly in the BRCA and POGL layer types. These layer types result mainly from scarification such as bulldozer-piling. Gophers are often absent on ABGR/ACGL sites unless repeated disturbances have occurred there.

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APPENDIX A-1: CONSTANCY[1] AND AVERAGE CANOPY COVER (PERCENT) OF TREES BY LAYER TYPE IN THE ABGR/ACGL H.T., ACGL PHASE, SHOWING SIZE CLASS DISTRIBUTION AND AVERAGE BASAL AREA

TREE LAYER GROUP		*Populus tremuloides*								*Pinus ponderosa*			
Tree layer type		POTR - POTR				POTR - ABGR				PIPO - PIPO			
Size class notation		p. POTR - p. POTR				p. POTR - p. ABGR				s. PIPO - s. PIPO			
Number of stands		*n* = 1				*n* = 1				*n* = 9			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	10(0.5)	10(15.0)	10(15.0)	10(20.0)	10(15.0)	—	—	2(1.8)	7(0.5)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	2(0.5)
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	1(0.5)
013	*Pinus ponderosa*	—	—	—	—	10(15.0)	—	—	—	—	—	—	10(12.2)
014	*Populus tremuloides*	—	—	10(31.0)	10(3.0)	—	—	10(15.0)	10(3.0)	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	—	—	—	—	—	—	—	3(3.0)	7(1.5)
	Average basal area (ft^2/acre)	—				161				4			

TREE LAYER GROUP		*Pinus ponderosa*											
Tree layer type		PIPO - PIPO				PIPO - ABGR							
Size class notation		p. PIPO - p. PIPO				s. PIPO - m. ABGR				m. PIPO - p. ABGR			
Number of stands		*n* = 1				*n* = 1				*n* = 3			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	10(0.5)	—	10(15.0)	—	10(3.0)	3(15.0)	7(20.2)	10(46.0)	10(7.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	10(15.0)	10(3.0)	—	—	—	10(15.0)	—	10(22.5)	—	3(3.0)
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	—	—	—	10(3.0)	10(2.0)	—	3(3.0)	7(3.0)	3(3.0)
	Average basal area (ft^2/acre)	13				45				254			

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX A-1 (Con.)[1]

TREE LAYER GROUP		Pinus ponderosa											
Tree layer type		PIPO - ABGR											
Size class notation		o.g. PIPO - s. ABGR				o.g. PIPO - p. ABGR				o.g. PIPO - o.g. ABGR			
Number of stands		*n* = 3				*n* = 1				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	3(44.0)	7(7.8)	10(10.1)	10(43.7)	10(10.0)	10(3.0)	10(20.0)	10(15.0)	10(37.5)	10(10.0)	10(15.0)	10(15.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	10(4.0)	10(3.0)	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	10(15.0)	—	3(0.5)	—	10(15.0)	—	—	—	10(15.0)	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	5(15.0)	5(3.0)	5(0.5)	—	—	—	—	—	—	10(15.0)	10(0.5)
Average basal area (ft²/acre)		198				231				293			

TREE LAYER GROUP		Pseudotsuga menziesii											
Tree layer type		PSME - PSME											
Size class notation		s. PSME - s. PSME				p. PSME - p. PSME				p. PSME - o.g. PSME			
Number of stands		*n* = 4				*n* = 1				*n* = 3			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	10(1.1)	—	—	10(3.0)	10(3.0)	6(15.0)	10(11.0)	10(9.0)	10(11.0)
002	*Abies lasiocarpa*	—	—	—	2(0.1)	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	3(0.5)
007	*Picea engelmannii*	—	—	—	2(3.0)	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	—	7(3.0)	—	—	—	—	3(1.0)	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	2(3.0)	10(13.8)	—	—	10(15.0)	10(3.0)	10(32.0)	6(15.0)	10(13.3)	3(0.5)
Average basal area (ft²/acre)		5				6				304			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-1 (Con.)[1]

TREE LAYER GROUP		Pseudotsuga menziesii											
Tree layer type		PSME - ABGR											
Size class notation		p. PSME - p. ABGR				p. PSME - o.g. ABGR				m. PSME - p. ABGR			
Number of stands		*n* = 2				*n* = 2				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	5(15.0)	10(37.5)	10(23.0)	10(50.0)	10(9.0)	10(15.0)	10(26.2)	—	10(15.0)	10(20.0)	10(4.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	5(3.0)	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	5(3.0)	5(3.0)	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	5(0.5)	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	5(3.0)	—	5(0.5)	—	—	—	—	—	10(3.0)	10(3.0)	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	5(15.0)	10(15.0)	—	—	—	10(12.5)	—	—	—	—	—
Average basal area (ft²/acre)		173				271				81			

TREE LAYER GROUP		Pseudotsuga menziesii								Picea engelmannii			
Tree layer type		PSME - ABGR								PIEN - PIEN			
Size clas notation		o.g. PSME - p. ABGR				o.g. PSME - o.g. ABGR				p. PIEN - p. PIEN			
Number of stands		*n* = 1				*n* = 1				*n* = 2			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	10(15.0)	—	10(15.0)	—	10(3.0)	10(3.0)	—	5(3.0)	5(3.0)	10(1.8)
002	*Abies lasiocarpa*	—	—	—	—	—	—	10(3.0)	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	10(3.0)	—	—	—	—	—	—
007	*Picea engelmannii*	—	10(3.0)	—	—	—	—	—	—	5(3.0)	—	10(15.0)	5(3.0)
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	10(3.0)	—	—	—	—	—	—	—	—	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	10(15.0)	—	—	—	10(15.0)	—	—	10(0.5)	—	—	—	—
Average basal area (ft²/acre)		72				93				34			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-1 (Con.)[1]

TREE LAYER GROUP		*Picea engelmannii*				*Abies grandis*							
Tree layer type		PIEN - ABGR											
Size class notation		s. PIEN - p. ABGR				s. ABGR - s. ABGR				s. ABGR - p. ABGR			
Number of stands		*n* = 1				*n* = 2				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	10(15.0)	10(3.0)	—	—	10(3.0)	10(15.0)	10(15.0)	10(3.0)	10(37.5)	10(15.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	10(3.0)	—	10(0.1)
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	10(3.0)	—	10(15.0)	—	—	—	—	—	—	—	10(3.0)
010	*Pinus contorta*	—	—	—	10(0.5)	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	—	10(0.5)	—	—	—	10(0.5)	—	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	10(0.5)	—	—	5(3.0)	5(0.5)	—	—	—	10(3.0)
	Average basal area (ft^2/acre)	19				8				162			

TREE LAYER GROUP		*Abies grandis*											
Tree layer type		ABGR - ABGR											
Size class notation		s. ABGR - o.g. ABGR				p. ABGR - p. ABGR				p. ABGR - m. ABGR			
Number of stands		*n* = 1				*n* = 6				*n* = 3			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	10(37.5)	—	10(20.0)	10(15.0)	2(4.0)	5(3.0)	10(15.0)	5(2.2)	10(11.0)	10(22.5)	10(15.0)	10(3.0)
002	*Abies lasiocarpa*	—	—	—	—	—	2(3.0)	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	2(0.5)	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	2(3.0)	3(3.0)	3(0.5)	—	—	3(3.0)	3(0.5)
010	*Pinus contorta*	—	—	—	—	—	—	—	2(0.5)	—	—	—	—
013	*Pinus ponderosa*	—	—	—	—	—	—	—	3(1.8)	—	—	—	3(0.1)
014	*Populus tremuloides*	—	—	—	—	—	—	—	2(3.0)	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	10(0.5)	—	—	2(3.0)	3(0.5)	—	3(3.0)	—	3(0.5)
	Average basal area (ft^2/acre)	183				39				138			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-1 (Con.)[1]

TREE LAYER GROUP		*Abies grandis*							
Tree layer type		ABGR - ABGR							
Size class notation		p. ABGR - o.g. ABGR				m. ABGR - m. ABGR			
Number of stands		*n* = 5				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species								
001	*Abies grandis*	10(28.5)	6(7.0)	10(15.0)	10(2.0)	—	10(15.0)	10(3.0)	10(3.0)
002	*Abies lasiocarpa*	—	—	2(3.0)	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	2(3.0)	2(3.0)	2(3.0)	4(0.4)	—	—	—	—
010	*Pinus contorta*	—	—	2(3.0)	—	—	—	—	—
013	*Pinus ponderosa*	—	—	—	2(0.5)	—	—	—	10(0.5)
014	*Populus tremuloides*	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	2(3.0)	4(3.0)	4(0.4)	—	—	—	10(0.5)
	Average basal area (ft^2/acre)	200				63			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

APPENDIX A-2: CONSTANCY[1] AND AVERAGE CANOPY COVER (PERCENT) OF TREES BY LAYER TYPE IN THE ABGR/ACGL H.T., PHMA PHASE, SHOWING SIZE CLASS DISTRIBUTION AND AVERAGE BASAL AREA

TREE LAYER GROUP		*Populus tremuloides*								*Pinus ponderosa*			
Tree layer type		POTR - POTR				POTR - ABGR				PIPO - PIPO			
Size class notation		p. POTR - p. POTR				s. POTR - s. ABGR				s. PIPO - s. PIPO			
Number of stands		*n* = 1				*n* = 1				*n* = 14			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	10(0.8)	—	—	—	10(37.5)	—	—	—	6(1.1)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	1(3.0)	—	1(0.5)
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	2(0.5)
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	1(2.0)	1(0.5)
013	*Pinus ponderosa*	—	—	—	—	—	—	—	10(3.0)	—	—	1(3.0)	10(18.4)
014	*Populus tremuloides*	—	—	10(37.5)	10(3.0)	—	—	10(3.0)	10(15.0)	—	—	—	1(0.5)
016	*Pseudotsuga menziesii*	—	—	—	10(0.8)	—	—	10(3.0)	10(0.5)	—	—	1(0.5)	6(1.3)
Average basal area (ft[2]/acre)		31				31				8			

TREE LAYER GROUP		*Pinus ponderosa*											
Tree layer type		PIPO - PIPO											
Size class notation		s. PIPO - p. PIPO				s. PIPO - o.g. PIPO				p. PIPO - p. PIPO			
Number of stands		*n* = 1				*n* = 1				*n* = 3			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	10(0.5)	—	—	—	10(0.5)	—	—	—	—
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	10(15.0)	10(15.0)	10(10.0)	—	—	10(10.0)	—	—	10(45.8)	3(3.0)
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	3(3.0)
016	*Pseudotsuga menziesii*	—	—	—	10(3.0)	—	—	—	—	—	—	—	—
Average basal area (ft[2]/acre)		36				68				32			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-2 (Con.)[1]

TREE LAYER GROUP		Pinus ponderosa											
Tree layer type		PIPO - PIPO				PIPO - PSME							
Size class notation		o.g. PIPO - o.g. PIPO				o.g PIPO - p. PSME				o.g. PIPO - m. PSME			
Number of stands		*n* = 1				*n* = 1				*n* = 14			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	—	—	—	10(3.0)	10(3.0)	10(3.0)	—	—	—
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	10(0.5)
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	10(10.0)	10(3.0)	—	—	10(15.0)	10(3.0)	—	10(0.5)	10(15.0)	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	—	—	10(3.0)	10(15.0)	10(0.5)	10(3.0)	10(15.0)	10(3.0)	—
Average basal area (ft²/acre)		32				135				443			

TREE LAYER GROUP		Pinus ponderosa											
Tree layer type		PIPO - ABGR											
Size class notation		p. PIPO - s. ABGR				p. PIPO - p. ABGR				m. PIPO - p. ABGR			
Number of stands		*n* = 1				*n* = 1				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	10(15.0)	10(37.5)	—	—	10(15.0)	10(0.5)	—	10(37.5)	10(37.5)	10(15.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	10(3.0)	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	10(3.0)	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	10(3.0)	10(15.0)	—	—	—	10(15.0)	10(3.0)	—	10(15.0)	10(3.0)	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	—	—	10(0.5)	—	—	—	—	—	10(3.0)	10(15.0)	10(0.5)
Average basal area (ft²/acre)		51				55				176			

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX A-2 (Con.)[1]

TREE LAYER GROUP		*Pinus ponderosa*				*Pseudotsuga menziesii*							
Tree layer type		PIPO - ABGR				PSME - PSME							
Size class notation		o.g. PIPO - p. ABGR				s. PSME - s. PSME				s. PSME - p. PSME			
Number of stands		*n* = 3				*n* = 3				*n* = 2			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	7(15.0)	3(15.0)	10(38.3)	10(16.7)	—	—	—	7(3.0)	—	—	—	5(0.5)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	10(15.0)	—	3(0.5)	—	—	—	—	7(0.5)	—	—	10(3.0)	5(0.5)
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	3(4.0)	3(15.0)	7(3.0)	7(3.0)	—	—	—	10(15.0)	—	5(3.0)	10(17.5)	10(12.5)
	Average basal area (ft²/acre)	198				1				24			

TREE LAYER GROUP		*Pseudotsuga menziesii*											
Tree layer type		PSME - PSME											
Size class notation		p. PSME - p. PSME				p. PSME - m. PSME				p. PSME - o.g. PSME			
Number of stands		*n* = 4				*n* = 1				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	2(3.0)	5(15.0)	10(1.8)	—	—	—	—	10(15.0)	10(3.0)	10(15.0)	10(0.5)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	2(3.0)	2(3.0)	2(0.5)	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	5(3.0)	2(3.0)	7(2.2)	—	—	—	—	—	10(3.0)	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	5(15.0)	10(19.4)	10(2.4)	—	10(20.0)	10(10.0)	10(0.5)	10(37.5)	10(3.0)	10(15.0)	10(3.0)
	Average basal area (ft²/acre)	63				120				286			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-2 (Con.)[1]

TREE LAYER GROUP		Pseudotsuga menziesii											
Tree layer type		PSME - PSME				PSME - ABGR							
Size class notation		m. PSME - o.g. PSME				s. PSME - s. ABGR				p. PSME - p. ABGR			
Number of stands		*n* = 1				*n* = 1				*n* = 2			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	—	—	—	—	—	—	10(15.0)	—	5(37.5)	10(37.5)	10(9.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	—	—	—	—	—	10(3.0)	—	—	5(3.0)	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	10(15.0)	10(10.0)	—	10(3.0)	—	—	—	10(15.0)	5(15.0)	5(15.0)	10(15.0)	
Average basal area (ft^2/acre)		144				—				178			

TREE LAYER GROUP		Pseudotsuga menziesii								Abies grandis			
Tree layer type		PSME - ABGR								ABGR - ABGR			
Size class notation		p. PSME - m. ABGR				o.g. PSME - p. ABGR				s. ABGR - o.g. ABGR			
Number of stands		*n* = 1				*n* = 5				*n* = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
001	*Abies grandis*	—	10(20.0)	10(3.0)	10(0.5)	10(17.3)	4(9.0)	10(34.0)	10(9.7)	10(37.5)	10(15.0)	10(0.5)	10(15.0)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	—	—	—	—	—	—	—	—	—
013	*Pinus ponderosa*	—	—	—	10(0.5)	—	4(1.8)	—	—	—	—	10(3.0)	10(3.0)
014	*Populus tremuloides*	—	—	—	—	—	—	—	—	—	—	—	—
016	*Pseudotsuga menziesii*	—	10(15.0)	—	—	10(31.3)	—	4(3.0)	2(3.0)	—	10(3.0)	10(3.0)	10(3.0)
Average basal area (ft^2/acre)		—				228				164			

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX A-2 (Con.)[1]

TREE LAYER GROUP		Abies grandis							
Tree layer type		ABGR-ABGR							
Size class notation		p. ABGR - p. ABGR				o.g. ABGR - o.g. ABGR			
Number of stands		$n = 4$				$n = 2$			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species								
001	*Abies grandis*	2(3.0)	5(15.0)	10(20.5)	10(1.1)	10(26.2)	—	5(3.0)	5(0.8)
002	*Abies lasiocarpa*	—	—	—	—	—	—	—	—
006	*Larix occidentalis*	—	—	—	—	—	—	—	—
007	*Picea engelmannii*	—	—	—	—	—	—	—	—
010	*Pinus contorta*	—	—	—	10(0.5)	—	—	—	5(0.5)
013	*Pinus ponderosa*	2(4.0)	—	10(3.0)	10(0.1)	—	—	—	—
014	*Populus tremuloides*	—	—	—	—	—	—	—	5(0.5)
016	*Pseudotsuga menziesii*	—	—	2(3.0)	5(0.5)	—	—	—	—
	Average basal area (ft^2/acre)		74				177		

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

APPENDIX B-1: PALATABILITY RATINGS, CONSTANCY,[1] AND AVERAGE CANOPY COVER (PERCENT) OF SHRUBS BY LAYER TYPE IN THE ABGR/ACGL H.T., ACGL PHASE

SHRUB LAYER GROUP												*Ceanothus velutinus*				
Shrub layer type												CEVE -CEVE	CEVE -SASC	CEVE -SPBE	CEVE -RUPA	CEVE -ACGL
Number of stands												*n* = 8	*n* = 6	*n* = 3	*n* = 3	*n* = 2
	Palatability ratings[2]	Deer		Elk		Cattle	Sheep	Black Bear								
ADP No.	Shrub species	Summer	Winter	Summer	Winter	Summer	Summer	Spring	Summer	Fall						
102	*Acer glabrum*	4	6	6	6	4	4	0	0	0		10(11.2)	8(12.3)	10(18.5)	10(6.2)	10(15.0)
104	*Alnus sinuata*	2	2	2	2	2	2	0	0	0		0(0.0)	2(15.0)	0(0.0)	0(0.0)	0(0.0)
105	*Amelanchier alnifolia*	4	4	6	6	4	6	2	6	6		5(2.4)	3(1.8)	0(0.0)	7(1.8)	0(0.0)
203	*Berberis repens*	2	4	2	4	2	4	2	2	2		3(7.8)	0(0.0)	0(0.0)	3(0.5)	0(0.0)
198	*Ceanothus sanguineus*	6	4	6	6	2	2	0	0	0		0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)
107	*Ceanothus velutinus*	6	4	6	6	2	2	0	0	0		10(70.3)	10(22.5)	10(30.0)	10(30.0)	10(38.8)
204	*Clematis columbiana*	0	0	0	0	0	0	4	4	2		1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
115	*Lonicera utahensis*	2	4	6	4	2	2	2	4	4		9(2.9)	2(15.0)	10(1.3)	10(3.0)	5(0.5)
118	*Pachistima myrsinites*	4	6	4	4	2	4	0	0	0		1(0.5)	2(3.0)	0(0.0)	0(0.0)	0(0.0)
122	*Physocarpus malvaceus*	4	2	4	2	2	4	0	0	0		5(14.6)	7(6.0)	0(0.0)	0(0.0)	0(0.0)
123	*Prunus emarginata*	4	4	6	4	2	2	2	4	6		4(2.2)	3(3.0)	10(0.5)	7(1.8)	5(3.0)
124	*Prunus virginiana*	4	4	4	6	2	2	2	4	6		1(0.5)	2(3.0)	3(0.5)	3(3.0)	0(0.0)
128	*Ribes cereum*	4	6	2	6	2	2	2	6	4		4(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
130	*Ribes lacustre*	4	6	6	6	2	4	2	6	4		1(3.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)
131	*Ribes viscosissimum*	4	6	6	6	2	4	2	6	4		10(3.9)	3(0.5)	10(6.2)	10(6.2)	10(3.0)
133	*Rosa gymnocarpa*	6	4	6	4	2	4	0	0	0		5(0.5)	7(1.1)	3(0.5)	10(0.5)	5(0.5)
161	*Rosa nutkana*	6	4	6	4	2	4	0	0	0		1(0.5)	2(3.0)	3(0.5)	0(0.0)	10(0.5)
136	*Rubus parviflorus*	4	2	6	2	2	4	2	4	2		3(20.3)	10(16.1)	3(15.0)	10(37.5)	0(0.0)
137	*Salix scouleriana*	6	6	6	6	2	4	0	0	0		8(13.0)	10(42.1)	3(15.0)	10(15.0)	10(9.0)
164	*Sambucus cerulea*	0	0	6	6	4	4	2	2	2		4(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)
138	*Sambucus racemosa*	0	0	6	6	4	4	2	2	2		4(0.5)	0(0.0)	3(0.5)	3(0.5)	5(0.5)
139	*Shepherdia canadensis*	2	2	2	4	2	4	2	6	4		0(0.0)	3(1.8)	0(0.0)	3(3.0)	0(0.0)
140	*Sorbus scopulina*	6	4	6	4	2	4	2	2	6		1(3.0)	5(2.2)	3(0.5)	7(1.8)	5(0.5)
142	*Spiraea betulifolia*	4	4	4	4	2	4	0	0	0		6(15.8)	8(21.6)	10(37.5)	7(9.0)	5(0.5)
143	*Symphoricarpos albus*	4	2	6	6	2	4	2	2	2		1(3.0)	5(2.2)	0(0.0)	0(0.0)	0(0.0)
163	*Symphoricarpos oreophilus*	4	2	2	4	2	4	2	2	2		4(6.2)	5(2.2)	7(7.8)	3(3.0)	10(9.0)
146	*Vaccinium globulare*	6	4	6	2	2	4	2	6	4		6(9.7)	7(9.0)	7(1.8)	7(19.0)	5(62.5)
Years since disturbance - average:												14	15	14	15	—
- range:												10-19	9-21	7-22	8-22	9-11

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX B-1 (Con.)

SHRUB LAYER GROUP		Ribes viscossimum						Salix scouleriana				
Shrub layer type		RIVI -RIVI	RIVI -SASC	RIVI -ALSI	RIVI -SPBE	RIVI -RUPA	RIVI -ACGL	SASC -SASC	SASC -ALSI	SASC -SPBE	SASC -RUPA	SASC -ACGL
Number of stands		*n* = 4	*n* = 1	*n* = 3	*n* = 1	*n* = 3	*n* = 1	*n* = 2	*n* = 1	*n* = 1	*n* = 5	n = 6
ADP No.	Shrub species											
102	*Acer glabrum*	8(6.2)	0(0.0)	7(15.0)	10(0.5)	10(10.2)	10(15.0)	10(15.0)	10(3.0)	10(3.0)	6(10.2)	10(16.7)
104	*Alnus sinuata*	0(0.0)	0(0.0)	10(54.2)	0(0.0)	3(15.0)	0(0.0)	0(0.0)	10(62.0)	0(0.0)	2(3.0)	2(3.0)
105	*Amelanchier alnifolia*	8(0.5)	10(0.5)	3(3.0)	0(0.0)	7(3.0)	10(3.0)	5(0.5)	10(3.0)	0(0.0)	8(1.1)	8(1.5)
203	*Berberis repens*	0(. 0.0)	10(0.5)	3(0.5)	0(0.0)	0(0.0)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	2(0.5)	2(0.5)
198	*Ceanothus sanguineus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
107	*Ceanothus velutinus*	10(3.0)	10(0.5)	0(0.0)	10(0.5)	7(3.0)	10(0.5)	10(3.0)	0(0.0)	10(0.5)	10(2.0)	2(3.0)
204	*Clematis columbiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)
115	*Lonicera utahensis*	10(4.8)	10(3.0)	10(6.2)	10(3.0)	10(2.2)	10(3.0)	5(0.5)	10(3.0)	10(0.5)	8(2.4)	8(4.9)
118	*Pachistima myrsinites*	3(3.0)	0(0.0)	3(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(15.0)	0(0.0)
122	*Physocarpus malvaceus*	8(6.2)	0(0.0)	7(9.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	10(37.5)	10(0.5)	6(6.2)	7(32.5)
123	*Prunus emarginata*	8(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	10(26.3)	0(0.0)	10(0.5)	2(15.0)	2(15.0)
124	*Prunus virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	2(3.0)
128	*Ribes cereum*	5(0.5)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
130	*Ribes lacustre*	5(3.0)	0(0.0)	10(11.0)	10(0.5)	10(1.3)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	2(0.5)	2(0.5)
131	*Ribes viscosissimum*	10(37.5)	10(15.0)	7(7.8)	10(15.0)	10(15.0)	10(15.0)	10(0.5)	0(0.0)	10(3.0)	8(2.4)	7(0.5)
133	*Rosa gymnocarpa*	5(1.8)	0(0.0)	7(0.5)	10(0.5)	7(0.5)	0(0.0)	10(0.5)	0(0.0)	10(3.0)	8(1.1)	5(1.3)
161	*Rosa nutkana*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	3(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(0.5)	3(0.5)
136	*Rubus parviflorus*	8(5.3)	10(0.5)	10(6.2)	10(0.5)	10(45.8)	10(3.0)	10(0.5)	10(3.0)	10(0.5)	10(62.0)	10(1.3)
137	*Salix scouleriana*	10(11.4)	10(15.0)	10(1.3)	10(3.0)	10(10.2)	10(3.0)	10(37.5)	10(15.0)	10(15.0)	10(29.0)	10(16.8)
164	*Sambucus cerulea*	3(0.5)	0(0.0)	0(0.0)	10(0.5)	3(0.5)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)
138	*Sambucus racemosa*	5(1.8)	0(0.0)	3(15.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(0.5)	0(0.0)
139	*Shepherdia canadensis*	3(0.5)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	3(3.0)
140	*Sorbus scopulina*	5(1.8)	0(0.0)	3(3.0)	0(0.0)	7(0.5)	10(0.5)	10(1.8)	0(0.0)	10(0.5)	2(0.5)	8(1.0)
142	*Spiraea betulifolia*	8(3.0)	10(15.0)	7(15.0)	10(37.5)	10(7.0)	10(3.0)	10(3.0)	10(3.0)	10(15.0)	8(14.6)	8(7.8)
143	*Symphoricarpos albus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	7(7.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(9.0)	0(0.0)
163	*Symphoricarpos oreophilus*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	10(0.5)	0(0.0)	3(9.0)
146	*Vaccinium globulare*	8(6.2)	0(0.0)	7(26.3)	10(0.5)	3(3.0)	10(3.0)	5(3.0)	10(15.0)	10(0.5)	6(6.2)	8(40.1)
Years since disturbance - average:		8	—	9	—	11	—	—	—	—	25	24
- range:		6-10	11	7-11	—	5-14	9	15-22	—	16	7-72	13-49

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX B-1 (Con.)[1]

SHRUB LAYER GROUP		*Alnus sinuata*			*Spiraea betulifolia*			*Rubus parviflorus*		*Acer glabrum*
Shrub layer type		ALSI -ALSI	ALSI -RUPA	ALSI -ACGL	SPBE -SPBE	SPBE -RUPA	SPBE -ACGL	RUPA -RUPA	RUPA -ACGL	ACGL -ACGL
Number of stands		*n* = 2	*n* = 1	*n* = 1	*n* = 2	*n* = 1	*n* = 2	*n* = 2	*n* = 4	*n* = 15
ADP No.	Shrub species									
102	*Acer glabrum*	10(26.3)	10(15.0)	10(37.5)	10(9.0)	10(3.0)	10(15.0)	5(3.0)	10(23.9)	10(21.9)
104	*Alnus sinuata*	10(73.8)	10(62.5)	10(37.5)	0(0.0)	0(0.0)	0(0.0)	5(3.0)	0(0.0)	1(0.5)
105	*Amelanchier alnifolia*	10(3.0)	0(0.0)	10(0.5)	10(0.5)	10(15.0)	10(19.0)	5(15.0)	10(5.4)	5(3.6)
203	*Berberis repens*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
198	*Ceanothus sanguineus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
107	*Ceanothus velutinus*	5(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	5(0.5)	0(0.0)	5(1.8)	2(1.3)
204	*Clematis columbiana*	5(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(2.4)
115	*Lonicera utahensis*	10(3.0)	10(0.5)	10(0.5)	0(0.0)	10(3.0)	5(15.0)	10(9.0)	10(14.6)	9(6.8)
118	*Pachistima myrsinites*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(15.0)	0(0.0)	0(0.0)	0(0.0)
122	*Physocarpus malvaceus*	10(9.0)	10(3.0)	10(15.0)	5(0.5)	10(15.0)	10(20.3)	5(0.5)	10(17.6)	7(16.8)
123	*Prunus emarginata*	0(0.0)	0(0.0)	0(0.0)	10(1.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(1.8)
124	*Prunus virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(2.2)
128	*Ribes cereum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
130	*Ribes lacustre*	10(0.5)	10(3.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	5(3.0)	0(0.0)	1(0.5)
131	*Ribes viscosissimum*	5(0.5)	10(0.5)	10(0.5)	5(0.5)	10(3.0)	0(0.0)	5(0.5)	8(2.2)	5(0.8)
133	*Rosa gymnocarpa*	5(3.0)	0(0.0)	10(0.5)	5(3.0)	10(3.0)	5(3.0)	5(3.0)	8(2.2)	7(1.2)
161	*Rosa nutkana*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
136	*Rubus parviflorus*	10(38.8)	10(62.5)	10(15.0)	10(1.8)	10(15.0)	0(0.0)	10(37.5)	10(15.0)	8(1.8)
137	*Salix scouleriana*	10(3.0)	10(3.0)	10(3.0)	5(0.5)	10(0.5)	5(3.0)	10(3.0)	3(3.0)	4(2.2)
164	*Sambucus cerulea*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	1(0.5)
138	*Sambucus racemosa*	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(15.0)	0(0.0)	1(0.5)
139	*Shepherdia canadensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(3.0)
140	*Sorbus scopulina*	10(1.8)	10(0.5)	10(0.5)	0(0.0)	10(0.5)	5(0.5)	5(0.5)	5(0.5)	8(3.8)
142	*Spiraea betulifolia*	5(3.0)	10(0.5)	0(0.0)	10(20.3)	10(15.0)	10(15.0)	5(3.0)	8(3.0)	5(1.2)
143	*Symphoricarpos albus*	0(0.0)	0(0.0)	0(0.0)	5(37.5)	0(0.0)	5(15.0)	0(0.0)	5(1.8)	3(1.0)
163	*Symphoricarpos oreophilus*	0(0.0)	0(0.0)	0(0.0)	5(3.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	3(12.0)
146	*Vaccinium globulare*	10(15.0)	0(0.0)	10(0.5)	5(3.0)	10(3.0)	5(31.5)	5(3.0)	8(6.2)	6(10.0)
Years since disturbance - average:		—	—	—	—	—	—	—	41	57
- range:		15-20	7	20	16-25	5	60-85	7-49	12-70	11-110

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

APPENDIX B-2: PALATABILITY RATINGS, CONSTANCY,[1] AND AVERAGE CANOPY COVER (PERCENT) OF SHRUBS BY LAYER TYPE IN THE ABGR/ACGL H.T., PHMA PHASE

SHRUB LAYER GROUP

Shrub layer type

Number of stands

ADP No.	Palatability ratings[2] Shrub species	Deer Summer	Deer Winter	Elk Summer	Elk Winter	Cattle Summer	Sheep Summer	Black Bear Spring	Black Bear Summer	Black Bear Fall
102	*Acer glabrum*	4	6	6	6	4	4	0	0	0
104	*Alnus sinuata*	2	2	2	2	2	2	0	0	0
105	*Amelanchier alnifolia*	4	4	6	6	4	6	2	6	6
203	*Berberis repens*	2	4	2	4	2	4	2	2	2
198	*Ceanothus sanguineus*	6	4	6	6	2	2	0	0	0
107	*Ceanothus velutinus*	6	4	6	6	2	2	0	0	0
204	*Clematis columbiana*	0	0	0	0	0	0	4	4	2
115	*Lonicera utahensis*	2	4	6	4	2	2	2	4	4
118	*Pachistima myrsinites*	4	6	4	4	2	4	0	0	0
122	*Physocarpus malvaceus*	4	2	4	2	2	4	0	0	0
123	*Prunus emarginata*	4	4	6	4	2	2	2	4	6
124	*Prunus virginiana*	4	4	4	6	2	2	2	4	6
128	*Ribes cereum*	4	6	2	6	2	2	2	6	4
130	*Ribes lacustre*	4	6	6	6	2	4	2	6	4
131	*Ribes viscosissimum*	4	6	6	6	2	4	2	6	4
133	*Rosa gymnocarpa*	6	4	6	4	2	4	0	0	0
161	*Rosa nutkana*	6	4	6	4	2	4	0	0	0
136	*Rubus parviflorus*	4	2	6	2	2	4	2	4	2
137	*Salix scouleriana*	6	6	6	6	2	4	0	0	0
164	*Sambucus cerulea*	0	0	6	6	4	4	2	2	2
138	*Sambucus racemosa*	0	0	6	6	4	4	2	2	2
139	*Shepherdia canadensis*	2	2	2	4	2	4	2	6	4
140	*Sorbus scopulina*	6	4	6	4	2	4	2	2	6
142	*Spiraea betulifolia*	4	4	4	4	2	4	0	0	0
143	*Symphoricarpos albus*	4	2	6	6	2	4	2	2	2
163	*Symphoricarpos oreophilus*	4	2	2	4	2	4	2	2	2
146	*Vaccinium globulare*	6	4	6	2	2	4	2	6	4

Years since disturbance - average:
- range:

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX B-2 (Con.)

SHRUB LAYER GROUP		Ceanothus velutinus						Ribes viscosissimum			
Shrub layer type		CEVE -CEVE	CEVE -RIVI	CEVE -SASC	CEVE -SPBE	CEVE -RUPA	CEVE -PHMA	RIVI -RIVI	RIVI -SASC	RIVI -SPBE	RIVI -PHMA
Number of stands		*n* = 10	*n* = 4	*n* = 12	*n* = 4	*n* = 1	*n* = 4	*n* = 1	*n* = 1	*n* = 1	*n* = 3
ADP No.	Shrub species										
102	*Acer glabrum*	3(1.3)	5(0.5)	5(2.2)	10(8.4)	10(3.0)	8(1.3)	0(0.0)	0(0.0)	10(0.5)	7(1.8)
104	*Alnus sinuata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
105	*Amelanchier alnifolia*	4(1.8)	8(1.3)	5(0.9)	8(13.7)	10(3.0)	3(0.5)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
203	*Berberis repens*	2(0.5)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
198	*Ceanothus sanguineus*	1(37.5)	0(0.0)	1(15.0)	3(37.5)	10(15.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
107	*Ceanothus velutinus*	9(67.2)	10(15.0)	9(23.2)	8(22.5)	0(0.0)	10(15.0)	10(0.5)	10(3.0)	10(0.5)	10(2.2)
204	*Clematis columbiana*	0(0.0)	3(0.5)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
115	*Lonicera utahensis*	8(4.4)	10(5.4)	6(3.3)	8(0.5)	10(3.0)	3(3.0)	10(0.5)	10(3.0)	10(0.5)	7(9.0)
118	*Pachistima myrsinites*	0(0.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	5(19.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
122	*Physocarpus malvaceus*	10(18.1)	10(11.4)	10(16.8)	10(20.6)	10(15.0)	10(56.3)	10(3.0)	10(3.0)	10(15.0)	10(10.2)
123	*Prunus emarginata*	4(5.4)	3(0.5)	4(9.4)	3(0.5)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	0(0.0)	3(0.5)
124	*Prunus virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
128	*Ribes cereum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
130	*Ribes lacustre*	1(0.5)	0(0.0)	1(0.5)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
131	*Ribes viscosissimum*	6(8.2)	10(20.6)	7(5.7)	8(2.2)	10(0.5)	3(0.5)	10(37.5)	10(15.0)	10(15.0)	10(15.0)
133	*Rosa gymnocarpa*	6(1.8)	8(0.5)	6(0.9)	5(0.5)	0(0.0)	5(1.8)	10(0.5)	0(0.0)	0(0.0)	7(0.5)
161	*Rosa nutkana*	1(0.5)	0(0.0)	2(0.5)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	3(0.5)
136	*Rubus parviflorus*	9(6.0)	10(1.8)	4(4.9)	10(8.4)	10(85.0)	5(1.8)	0(0.0)	10(0.5)	10(0.5)	7(1.8)
137	*Salix scouleriana*	9(13.7)	10(5.4)	10(38.1)	8(5.3)	10(62.5)	10(20.6)	10(3.0)	10(15.0)	10(3.0)	10(2.2)
164	*Sambucus cerulea*	2(3.0)	10(2.4)	1(0.5)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	3(3.0)
138	*Sambucus racemosa*	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)
139	*Shepherdia canadensis*	1(0.5)	0(0.0)	1(0.5)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
140	*Sorbus scopulina*	4(0.5)	8(0.5)	0(0.0)	3(0.5)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
142	*Spiraea betulifolia*	8(7.3)	10(1.8)	9(6.7)	10(31.9)	0(0.0)	5(3.0)	10(0.5)	10(3.0)	10(15.0)	7(1.8)
143	*Symphoricarpos albus*	3(6.2)	5(0.5)	6(7.4)	5(7.8)	0(0.0)	10(8.4)	10(0.5)	10(3.0)	0(0.0)	7(0.5)
163	*Symphoricarpos oreophilus*	0(0.0)	0(0.0)	4(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
146	*Vaccinium globulare*	5(7.3)	10(5.4)	3(5.4)	5(3.0)	10(0.5)	5(7.8)	10(0.5)	10(0.5)	0(0.0)	7(1.8)
Year since disturbance - average:		19	11	23	17	—	34	—	—	—	10
- range:		11-51	8-13	8-49	7-40	55	12-70	3	7	8	8-12

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX B-2 (Con.)

SHRUB LAYER GROUP		*Salix scouleriana*				*Spiraea betulifolia*			*Rubus parviflorus*	*Physocarpus malvaceus*
Shrub layer type		SASC -SASC	SASC -SPBE	SASC -RUPA	SASC -PHMA	SPBE -SPBE	SPBE -RUPA	SPBE -PHMA	RUPA -PHMA	PHMA -PHMA
Number of stands		*n* = 2	*n* = 4	*n* = 2	*n* = 9	*n* = 1	*n* = 1	*n* = 8	*n* = 2	*n* = 6
ADP No.	Shrub species									
102	*Acer glabrum*	0(0.0)	0(0.0)	10(1.8)	6(2.5)	0(0.0)	10(0.5)	6(2.5)	10(3.0)	7(1.8)
104	*Alnus sinuata*	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
105	*Amelanchier alnifolia*	5(3.0)	8(1.3)	5(3.0)	7(4.2)	10(0.5)	0(0.0)	6(2.0)	10(9.0)	3(0.5)
203	*Berberis repens*	0(0.0)	8(0.5)	0(0.0)	3(1.3)	0(0.0)	0(0.0)	1(0.5)	5(0.5)	2(0.5)
198	*Ceanothus sanguineus*	0(0.0)	0(0.0)	5(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
107	*Ceanothus velutinus*	5(3.0)	5(1.8)	10(1.8)	4(2.4)	0(0.0)	10(0.5)	6(1.0)	0(0.0)	5(2.2)
204	*Clematis columbiana*	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(0.5)	2(0.5)
115	*Lonicera utahensis*	10(1.8)	5(1.8)	5(0.5)	6(3.4)	0(0.0)	10(0.5)	8(2.2)	10(0.5)	7(1.1)
118	*Pachistima myrsinites*	0(0.0)	0(0.0)	0(0.0)	2(31.5)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
122	*Physocarpus malvaceus*	5(15.0)	10(17.0)	10(15.0)	10(51.4)	10(15.0)	10(3.0)	10(29.4)	10(37.5)	10(22.5)
123	*Prunus emarginata*	10(7.8)	5(1.8)	10(19.0)	1(37.5)	0(0.0)	0(0.0)	3(3.0)	0(0.0)	7(0.5)
124	*Prunus virginiana*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
128	*Ribes cereum*	5(3.0)	3(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
130	*Ribes lacustre*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(3.0)	0(0.0)	0(0.0)
131	*Ribes viscosissimum*	0(0.0)	8(1.3)	10(1.8)	1(0.5)	10(0.5)	10(0.5)	5(2.4)	5(3.0)	7(0.5)
133	*Rosa gymnocarpa*	0(0.0)	5(1.8)	5(0.5)	9(1.1)	10(0.5)	0(0.0)	8(1.3)	10(3.0)	5(1.3)
161	*Rosa nutkana*	5(3.0)	3(0.5)	5(3.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	3(0.5)
136	*Rubus parviflorus*	5(0.5)	3(0.5)	10(62.5)	4(4.8)	0(0.0)	10(85.0)	9(0.5)	10(26.3)	3(0.5)
137	*Salix scouleriana*	10(50.0)	10(20.6)	10(50.0)	10(22.8)	0(0.0)	10(3.0)	5(1.1)	0(0.0)	7(1.1)
164	*Sambucus cerulea*	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(3.0)
138	*Sambucus racemosa*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
139	*Shepherdia canadensis*	0(0.0)	3(0.5)	5(0.5)	1(37.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)
140	*Sorbus scopulina*	10(7.8)	0(0.0)	5(3.0)	1(0.5)	0(0.0)	10(3.0)	3(7.8)	5(0.5)	2(0.5)
142	*Spiraea betulifolia*	5(0.5)	10(25.9)	5(0.5)	8(6.1)	10(37.5)	0(0.0)	9(21.4)	10(0.5)	5(1.3)
143	*Symphoricarpos albus*	10(0.5)	10(26.3)	5(15.0)	4(1.1)	10(3.0)	10(15.0)	6(3.9)	10(1.8)	3(0.5)
163	*Symphoricarpos oreophilus*	10(3.0)	5(7.8)	0(0.0)	1(3.0)	0(0.0)	0(0.0)	3(0.5)	5(0.5)	7(8.4)
146	*Vaccinium globulare*	0(0.0)	3(3.0)	10(3.0)	6(23.7)	0(0.0)	0(0.0)	4(18.5)	10(38.8)	0(0.0)
Years since disturbance - average:		—	35	—	54	—	—	62	—	34
- range:		12-55	14-70	17-55	12-80	77	9	7-100	80-80	4-110

[1]Code to constancy values: + = 0 - 5%; 1 = 5 -15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

APPENDIX C-1: PALATABILITY RATINGS, CONSTANCY,[1] AND AVERAGE CANOPY COVER (PERCENT) OF HERBACEOUS SPECIES BY HERB LAYER TYPE IN THE ABGR/ACGL H.T., ACGL PHASE

HERB LAYER GROUP

Herb layer type

Number of stands

ADP No.	Palatability ratings[2]	Deer Summer	Deer Winter	Elk Summer	Elk Winter	Cattle Summer	Sheep Summer	Black Bear Spring	Black Bear Summer	Black Bear Fall
	Perennial graminoids									
303	*Bromus carinatus*	4	2	6	4	6	4	0	0	0
282	*Bromus inermis*	4	4	6	4	6	4	0	0	0
304	*Bromus vulgaris*	4	2	4	4	6	4	0	0	0
307	*Calamagrostis rubescens*	2	4	6	4	6	4	6	4	2
309	*Carex geyeri*	4	4	6	6	6	4	6	4	2
284	*Carex microptera*	0	0	0	0	0	0	0	0	0
311	*Carex rossii*	2	2	4	2	2	4	6	4	2
318	*Festuca occidentalis*	4	4	4	6	6	6	0	0	0
	Ferns									
259	*Pteridium aquilinum*	4	0	2	0	2	4	0	0	0
	Perennial herbs									
401	*Achillea millefolium*	2	2	2	2	2	4	0	0	0
402	*Actaea rubra*	4	0	2	0	2	2	0	0	0
403	*Adenocaulon bicolor*	0	0	0	0	0	0	0	0	0
405	*Anaphalis margaritacea*	2	2	2	2	2	2	0	0	0
415	*Apocynum androsaemifolium*	2	0	2	0	2	2	0	0	0
420	*Arenaria macrophylla*	2	0	2	0	2	4	0	0	0
421	*Arnica cordifolia*	4	0	4	0	2	4	0	0	0
426	*Aster conspicuus*	2	2	4	2	4	4	0	0	0
429	*Astragalus canadensis*	2	0	4	0	2	4	0	0	0
438	*Castilleja miniata*	2	0	2	0	2	2	0	0	0
442	*Chimaphila umbellata*	0	0	0	0	0	0	0	0	0
445	*Circaea alpina*	0	0	0	0	0	0	0	0	0
*14	*Cirsium arvense*	2	2	2	2	2	2	0	0	0
455	*Disporum trachycarpum*	0	0	0	0	0	0	6	4	2
459	*Epilobium angustifolium*	4	2	6	2	2	4	0	0	0
465	*Fragaria vesca*	4	4	2	4	2	4	2	6	2
466	*Fragaria virginiana*	4	4	2	4	2	4	2	6	2
618	*Galium asperrimum*	0	0	0	0	0	0	4	2	2
471	*Galium triflorum*	2	0	2	0	2	4	4	2	2
473	*Geranium viscosissimum*	4	2	6	2	2	4	0	0	0
483	*Hieracium albertinum*	4	2	4	2	6	6	0	0	0

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP

Herb layer type

Number of stands

ADP No.	Palatability ratings[2]	Deer Summer	Deer Winter	Elk Summer	Elk Winter	Cattle Summer	Sheep Summer	Black Bear Spring	Black Bear Summer	Black Bear Fall
	Perennial herbs									
484	*Hieracium albiflorum*	4	2	4	2	6	6	0	0	0
833	*Iliamna rivularis*	4	0	6	0	4	6	0	0	0
636	*Lathyrus nevadensis*	4	2	4	2	6	6	0	0	0
505	*Osmorhiza chilensis*	2	0	2	0	2	4	6	4	2
509	*Pedicularis racemosa*	4	0	4	0	2	2	0	0	0
514	*Penstemon wilcoxii*	4	2	2	2	2	4	0	0	0
519	*Polemonium pulcherrimum*	4	0	4	0	2	4	0	0	0
522	*Potentilla glandulosa*	4	2	4	2	2	4	0	0	0
675	*Rudbeckia occidentalis*	4	2	2	2	2	4	0	0	0
542	*Smilacina racemosa*	6	2	4	2	2	4	6	4	2
543	*Smilacina stellata*	4	2	4	2	2	4	6	4	2
547	*Thalictrum occidentale*	4	2	6	2	2	4	0	0	0
562	*Thermopsis montana*	2	2	2	2	2	2	6	2	2
551	*Valeriana sitchensis*	4	0	6	0	2	4	0	0	0
691	*Veratrum californicum*	4	2	4	2	4	4	2	2	2
	Annuals, biennials, and short-lived perennials									
*12	*Cirsium vulgare*	2	2	2	2	2	2	0	0	0
902	*Collinsia parviflora*	2	0	2	0	2	2	0	0	0
921	*Collomia tenella*	2	0	2	0	2	2	0	0	0
#54	*Cryptantha* spp.	0	0	0	0	0	2	0	0	0
914	*Cryptantha affinis*	0	0	0	0	0	2	0	0	0
904	*Epilobium paniculatum*	2	0	2	0	2	2	0	0	0
930	*Gayophytum decipiens*	2	0	2	0	2	2	0	0	0
886	*Gnaphalium microcephalum*	2	0	2	0	2	4	0	0	0
874	*Gnaphalium viscosum*	2	0	2	0	2	4	0	0	0
908	*Montia perfoliata*	2	0	2	0	2	2	0	0	0
918	*Nemophila parviflora*	2	0	2	0	2	2	0	0	0
663	*Phacelia hastata*	4	2	4	2	2	4	0	0	0
911	*Polygonum douglasii*	2	0	2	0	2	2	0	0	0
*16	*Verbascum thapsus*	2	2	2	2	2	2	0	0	0
996	Moss									
998	Rock									
999	Bare soil									
Years since disturbance - average:										
- range:										

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		Annuals		*Bromus carinatus*		*Potentilla glandulosa*					
Herb layer type		ANN. -ANN.	ANN. -ARCO	BRCA -CAMI	BRCA -PTAQ	POGL -POGL	POGL -EPAN	POGL -CAMI	POGL -PTAQ	POGL -ARCO	POGL -THOC
Number of stands		*n* = 1	*n* = 2	*n* = 1	*n* = 1	*n* = 9	*n* = 1	*n* = 1	*n* = 1	*n* = 1	*n* = 3
ADP No.	**Perennial graminoids**										
303	*Bromus carinatus*	10(0.5)	0(0.0)	10(15.0)	10(15.0)	6(1.5)	10(0.5)	0(0.0)	10(0.5)	10(0.5)	3(0.5)
282	*Bromus inermis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
307	*Calamagrostis rubescens*	0(0.0)	0(0.0)	10(0.5)	0(0.0)	1(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
309	*Carex geyeri*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	10(0.5)	0(0.0)	7(0.5)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(5.3)	0(0.5)	0(0.0)	10(0.5)	10(0.5)	3(0.5)
311	*Carex rossii*	10(0.5)	10(3.0)	10(0.5)	0(0.0)	10(2.7)	10(0.5)	10(0.5)	0(0.0)	10(0.5)	7(1.8)
318	*Festuca occidentalis*	0(0.0)	0(0.0)	10(3.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Ferns										
259	*Pteridium aquilinum*	0(0.0)	0(0.0)	0(0.0)	10(15.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Perennial herbs										
401	*Achillea millefolium*	10(0.5)	5(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	10(0.5)	10(0.5)	0(0.0)	0(0.0)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
403	*Adenocaulon bicolor*	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
405	*Anaphalis margaritacea*	10(0.5)	5(0.5)	0(0.0)	0(0.0)	4(1.3)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	5(0.5)	0(0.0)	0(0.0)	1(3.0)	0(0.0)	0(0.0)	10(15.0)	0(0.0)	0(0.0)
420	*Arenaria macrophylla*	0(0.0)	5(0.5)	10(0.5)	10(0.5)	6(0.5)	10(3.0)	10(0.5)	0(0.0)	10(0.5)	0(0.0)
421	*Arnica cordifolia*	10(0.5)	10(7.8)	10(0.5)	0(0.0)	2(0.5)	10(0.5)	0(0.0)	10(3.0)	0(0.0)	0(0.0)
426	*Aster conspicuus*	0(0.0)	10(1.8)	0(0.0)	0(0.0)	4(0.5)	10(15.0)	0(0.0)	0(0.0)	0(0.0)	10(2.2)
429	*Astragalus canadensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(15.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
438	*Castilleja miniata*	0(0.0)	0(0.0)	10(15.0)	0(0.0)	6(4.4)	0(0.0)	10(15.0)	0(0.0)	0(0.0)	7(0.5)
442	*Chimaphila umbellata*	0(0.0)	0(0.0)	10(0.5)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
445	*Circaea alpina*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	10(0.5)	10(0.5)	0(0.0)
*14	*Cirsium arvense*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
459	*Epilobium angustifolium*	10(0.5)	10(1.8)	0(0.0)	0(0.0)	8(0.9)	10(15.0)	0(0.0)	10(0.5)	10(0.5)	10(2.2)
465	*Fragaria vesca*	10(0.5)	0(0.0)	10(3.0)	10(15.0)	4(1.8)	10(15.0)	10(3.0)	0(0.0)	10(0.5)	3(3.0)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(7.8)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
471	*Galium triflorum*	10(0.5)	5(0.5)	0(0.0)	0(0.0)	3(1.3)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)
473	*Geranium viscosissimum*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	3(5.3)	10(0.5)	0(0.0)	10(3.0)	0(0.0)	3(0.5)
483	*Hieracium albertinum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)

[1]Code to constancy values: + = 0 - 5%; 1 = 5 -15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		Annuals		*Bromus carinatus*		*Potentilla glandulosa*					
Herb layer type		ANN. ANN.	ANN. -ARCO	BRCA -CAMI	BRCA -PTAQ	POGL -POGL	POGL -EPAN	POGL -CAMI	POGL -PTAQ	POGL -ARCO	POGL -THOC
Number of stands		*n* = 1	*n* = 2	*n* = 1	*n* = 1	*n* = 7	*n* = 2	*n* = 1	*n* = 1	*n* = 1	*n* = 3
ADP No.	**Perennial herbs**										
484	*Hieracium albiflorum*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
833	*Iliamna rivularis*	0(0.0)	5(3.0)	0(0.0)	0(0.0)	4(14.0)	10(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
505	*Osmorhiza chilensis*	10(0.5)	10(0.5)	10(0.5)	0(0.0)	2(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
509	*Pedicularis racemosa*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
514	*Penstemon wilcoxii*	10(0.5)	0(0.0)	0(0.0)	0(0.0)	6(0.5)	10(0.5)	0(0.0)	10(0.5)	10(3.0)	10(0.5)
519	*Polemonium pulcherrimum*	0(0.0)	5(15.0)	0(0.0)	10(0.5)	7(1.8)	0(0.0)	10(0.5)	10(0.5)	10(15.0)	7(1.8)
522	*Potentilla glandulosa*	10(0.5)	10(1.8)	10(0.5)	10(3.0)	9(18.3)	10(15.0)	10(15.0)	10(15.0)	10(15.0)	10(15.0)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	4(0.5)	0(0.0)	0(0.0)	10(3.0)	10(0.5)	7(0.5)
542	*Smilacina racemosa*	0(0.0)	5(0.5)	10(0.5)	10(0.5)	7(0.5)	10(0.5)	0(0.0)	10(0.5)	10(0.5)	3(0.5)
543	*Smilacina stellata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
547	*Thalictrum occidentale*	0(0.0)	5(0.5)	10(0.5)	10(3.0)	8(1.2)	10(3.0)	10(3.0)	0(0.0)	10(0.5)	10(15.0)
562	*Thermopsis montana*	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	3(3.0)
551	*Valeriana sitchensis*	0(0.0)	5(0.5)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	10(0.5)	0(0.0)	10(3.0)	3(0.5)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	3(0.5)
	Annuals, biennials, and short-lived perennials										
*12	*Cirsium vulgare*	10(3.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
902	*Collinsia parviflora*	10(0.5)	10(9.0)	0(0.0)	10(0.5)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
921	*Collomia tenella*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
#54	*Cryptantha* spp.	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	10(0.5)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)
904	*Epilobium paniculatum*	10(3.0)	0(0.0)	0(0.0)	0(0.0)	2(1.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	10(15.0)	0(0.0)	0(0.0)	0(0.0)	2(1.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(3.0)
886	*Gnaphalium microcephalum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
908	*Montia perfoliata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
663	*Phacelia hastata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	6(0.5)	10(1.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	10(0.5)	5(15.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	10(0.5)	0(0.0)	10(0.5)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
996	Moss	10(0.5)	5(0.5)	10(15.0)	10(0.5)	3(3.0)	10(0.5)	10(0.5)	0(0.0)	10(0.5)	0(0.0)
998	Rock	0(0.0)	10(0.5)	10(0.5)	0(0.0)	8(1.2)	0(0.0)	10(3.0)	10(3.0)	10(0.5)	10(0.5)
999	Bare soil	10(15.0)	10(26.3)	10(3.0)	10(3.0)	10(9.4)	10(3.0)	10(3.0)	10(0.5)	10(15.0)	10(3.0)
Years since disturbance	- average:	6	4	11	11	11	16	14	19	15	17
	- range:	—	3 - 6	—	—	7 - 25	—	—	—	—	14 - 22

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		Epilobium angustifolium			Castilleja miniata	Pteridium aquilinum			Fragaria vesca		
Herb layer type		EPAN -EPAN	EPAN -FRVE	EPAN -ASCO	CAMI -THOC	PTAQ -PTAQ	PTAQ -ARCO	PTAQ -THOC	FRVE -FRVE	FRVE -ARCO	FRVE -THOC
Number of stands		*n* = 2	*n* = 1	*n* = 1	*n* = 2	*n* = 3	*n* = 1	*n* = 4	*n* = 1	*n* = 3	*n* = 1
ADP No.	**Perennial graminoids**										
303	*Bromus carinatus*	5(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(0.5)	10(0.5)	0(0.0)	10(0.5)
282	*Bromus inermis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	5(0.5)	0(0.0)	0(0.0)	10(1.8)	3(15.0)	10(0.5)	5(3.0)	10(0.5)	7(1.8)	0(0.0)
307	*Calamagrostis rubescens*	5(3.0)	10(15.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(22.5)	10(0.5)
309	*Carex geyeri*	0(0.0)	10(0.5)	10(0.5)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	10(0.5)	10(6.2)	10(3.0)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
311	*Carex rossii*	10(0.5)	10(0.5)	10(0.5)	10(0.5)	3(0.5)	0(0.0)	3(0.5)	10(0.5)	3(0.5)	10(0.5)
318	*Festuca occidentalis*	5(0.5)	0(0.0)	0(0.0)	5(0.5)	3(0.5)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
	Ferns										
259	*Pteridium aquilinum*	5(37.5)	0(0.0)	0(0.0)	5(0.5)	3(15.0)	0(0.0)	5(15.0)	0(0.0)	0(0.0)	0(0.0)
	Perennial herbs										
401	*Achillea millefolium*	5(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	7(0.5)	10(3.0)	5(1.8)	0(0.0)	0(0.0)	0(0.0)
403	*Adenocaulon bicolor*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(3.0)	10(0.5)	3(0.5)	0(0.0)	0(0.0)	0(0.0)
405	*Anaphalis margaritacea*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	7(3.0)	10(0.5)
420	*Arenaria macrophylla*	5(0.5)	0(0.0)	10(0.5)	5(0.5)	10(0.5)	0(0.0)	5(0.5)	10(0.5)	3(0.5)	10(0.5)
421	*Arnica cordifolia*	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	7(19.0)	0(0.0)
426	*Aster conspicuus*	5(3.0)	10(0.5)	10(37.5)	5(0.5)	3(0.5)	0(0.0)	3(0.5)	0(0.0)	7(0.5)	10(3.0)
429	*Astragalus canadensis*	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
438	*Castilleja miniata*	5(0.5)	10(3.0)	10(3.0)	10(15.0)	3(0.5)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)
442	*Chimaphila umbellata*	0(0.0)	10(0.5)	0(0.0)	5(0.5)	3(0.5)	0(0.0)	10(0.5)	0(0.0)	3(3.0)	0(0.0)
445	*Circaea alpina*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	7(50.0)	10(15.0)	5(15.0)	0(0.0)	3(3.0)	0(0.0)
*14	*Cirsium arvense*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
459	*Epilobium angustifolium*	10(38.8)	10(15.0)	10(15.0)	10(1.8)	7(0.5)	10(0.5)	5(0.5)	10(0.5)	7(1.8)	10(0.5)
465	*Fragaria vesca*	10(0.5)	10(15.0)	0(0.0)	5(0.5)	7(3.0)	10(0.5)	8(0.5)	10(15.0)	10(15.0)	10(15.0)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
471	*Galium triflorum*	5(0.5)	10(3.0)	0(0.0)	0(0.0)	10(2.2)	10(3.0)	10(4.1)	10(0.5)	7(0.5)	10(0.5)
473	*Geranium viscosissimum*	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)
483	*Hieracium albertinum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		*Epilobium angustifolium*			*Castilleja miniata*	*Pteridium aquilinum*			*Fragaria vesca*		
Herb layer type		EPAN -EPAN	EPAN -FRVE	EPAN -ASCO	CAMI -THOC	PTAQ -PTAQ	PTAQ -ARCO	PTAQ -THOC	FRVE -FRVE	FRVE -ARCO	FRVE -THOC
Number of stands		*n* = 2	*n* = 1	*n* = 1	*n* = 2	*n* = 3	*n* = 1	*n* = 4	*n* = 1	*n* = 3	*n* = 1
ADP No.	**Perennial herbs**										
484	*Hieracium albiflorum*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	3(3.0)	0(0.0)
833	*Iliamna rivularis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(37.5)	0(0.0)
505	*Osmorhiza chilensis*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	3(0.5)	0(0.0)	8(1.3)	0(0.0)	3(15.0)	10(0.5)
509	*Pedicularis racemosa*	0(0.0)	0(0.0)	10(0.5)	5(0.5)	0(0.0)	0(0.0)	8(2.2)	0(0.0)	0(0.0)	0(0.0)
514	*Penstemon wilcoxii*	5(0.5)	0(0.0)	10(0.5)	0(0.0)	3(15.0)	10(0.5)	0(0.0)	10(0.5)	3(3.0)	10(0.5)
519	*Polemonium pulcherrimum*	0(0.0)	0(0.0)	10(0.5)	10(1.8)	7(3.0)	10(15.0)	3(0.5)	0(0.0)	3(0.5)	0(0.0)
522	*Potentilla glandulosa*	10(0.5)	10(0.5)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	3(0.5)	10(0.5)	3(3.0)	10(3.0)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)
542	*Smilacina racemosa*	10(1.8)	10(0.5)	10(0.5)	0(0.0)	10(0.5)	10(0.5)	8(0.5)	0(0.0)	7(0.5)	10(0.5)
543	*Smilacina stellata*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
547	*Thalictrum occidentale*	10(7.8)	10(3.0)	10(3.0)	10(15.0)	10(2.2)	10(0.5)	10(12.0)	0(0.0)	7(15.0)	10(15.0)
562	*Thermopsis montana*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
551	*Valeriana sitchensis*	5(3.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)
	Annuals, biennials, and short-lived perennials										
*12	*Cirsium vulgare*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	7(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
902	*Collinsia parviflora*	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
921	*Collomia tenella*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
#54	*Cryptantha* spp.	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
904	*Epilobium paniculatum*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
886	*Gnaphalium microcephalum*	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
908	*Montia perfoliata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
663	*Phacelia hastata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
996	Moss	5(3.0)	10(0.5)	10(3.0)	10(0.5)	10(17.7)	0(0.0)	3(0.5)	10(3.0)	3(0.5)	10(0.5)
998	Rock	5(0.5)	10(0.5)	10(3.0)	10(1.8)	7(0.5)	0(0.0)	5(0.5)	10(0.5)	7(1.8)	0(0.0)
999	Bare soil	5(3.0)	10(3.0)	10(3.0)	10(9.0)	10(1.3)	10(3.0)	5(0.5)	10(3.0)	3(0.5)	10(3.0)
Years since disturbance	- average:	16	15	19	17	7	7	20	10	44	22
	- range:	15 - 17	—	—	16 - 18	7 - 8	—	20 - 49	—	12 - 100	—

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		Aster conspicuus		Arnica cordifolia		Thalictrum occidentale
Herb layer type		ASCO -ASCO	ASCO -THOC	ARCO -ARCO	ARCO -THOC	THOC -THOC
Number of stands		*n* = 4	*n* = 1	*n* = 8	*n* = 1	*n* = 9
ADP No.	**Perennial graminoids**					
303	*Bromus carinatus*	3(0.5)	10(0.5)	4(0.5)	0(0.0)	0(0.0)
282	*Bromus inermis*	3(0.5)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	3(3.0)	0(0.0)	1(3.0)	0(0.0)	4(5.4)
307	*Calamagrostis rubescens*	8(2.2)	0(0.0)	6(9.2)	10(0.5)	2(1.8)
309	*Carex geyeri*	10(0.5)	10(15.0)	4(0.5)	0(0.0)	2(0.5)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
311	*Carex rossii*	8(0.5)	0(0.0)	6(0.5)	10(0.5)	3(0.5)
318	*Festuca occidentalis*	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)
	Ferns					
259	*Pteridium aquilinum*	0(0.0)	0(0.0)	1(3.0)	0(0.0)	2(0.5)
	Perennial herbs					
401	*Achillea millefolium*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)
403	*Adenocaulon bicolor*	0(0.0)	0(0.0)	3(0.5)	0(0.0)	3(13.7)
405	*Anaphalis margaritacea*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	0(0.0)	1(0.5)	0(0.0)	1(0.5)
420	*Arenaria macrophylla*	5(7.8)	0(0.0)	8(0.5)	10(3.0)	6(0.5)
421	*Arnica cordifolia*	3(0.5)	10(0.5)	6(15.0)	0(0.0)	4(1.8)
426	*Aster conspicuus*	8(15.0)	0(0.0)	5(0.5)	0(0.0)	3(0.5)
429	*Astragalus canadensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
438	*Castilleja miniata*	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
442	*Chimaphila umbellata*	5(0.5)	0(0.0)	8(1.3)	0(0.0)	7(3.3)
445	*Circaea alpina*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	4(1.8)
*14	*Cirsium arvense*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	7(0.9)
459	*Epilobium angustifolium*	5(0.5)	0(0.0)	1(3.0)	10(0.5)	4(1.1)
465	*Fragaria vesca*	5(3.0)	10(0.5)	5(1.1)	0(0.0)	9(1.1)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
471	*Galium triflorum*	8(0.5)	10(0.5)	3(1.8)	10(0.5)	9(6.6)
473	*Geranium viscosissimum*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	1(0.5)
483	*Hieracium albertinum*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	1(0.5)

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX C-1 (Con.)[1]

HERB LAYER GROUP		Aster conspicuus		Arnica cordifolia		Thalictrum occidentale
Herb layer type		ASCO -ASCO	ASCO -THOC	ARCO -ARCO	ARCO -THOC	THOC -THOC
Number of stands		*n* = 4	*n* = 1	*n* = 8	*n* = 1	*n* = 9
ADP No.	**Perennial herbs**					
484	*Hieracium albiflorum*	3(0.5)	0(0.0)	6(0.5)	0(0.0)	2(0.5)
833	*Iliamna rivularis*	3(0.5)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	0(0.0)	0(0.0)	3(0.5)	0(0.0)	3(5.3)
505	*Osmorhiza chilensis*	5(0.5)	0(0.0)	8(0.9)	10(3.0)	8(0.5)
509	*Pedicularis racemosa*	0(0.0)	0(0.0)	3(0.5)	0(0.0)	1(0.5)
514	*Penstemon wilcoxii*	5(0.5)	0(0.0)	4(0.5)	0(0.0)	1(0.5)
519	*Polemonium pulcherrimum*	3(0.5)	0(0.0)	4(1.3)	10(15.0)	0(0.0)
522	*Potentilla glandulosa*	0(0.0)	10(0.5)	5(0.5)	10(0.5)	1(0.5)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
542	*Smilacina racemosa*	8(0.5)	10(0.5)	5(0.5)	10(3.0)	9(0.8)
543	*Smilacina stellata*	0(0.0)	0(0.0)	1(0.5)	10(3.0)	1(3.0)
547	*Thalictrum occidentale*	10(2.4)	10(37.5)	6(1.0)	10(62.5)	10(19.8)
562	*Thermopsis montana*	3(3.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
551	*Valeriana sitchensis*	0(0.0)	10(3.0)	3(9.0)	10(3.0)	3(0.5)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Annuals, biennials, and short-lived perennials					
*12	*Cirsium vulgare*	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
902	*Collinsia parviflora*	3(0.5)	0(0.0)	3(0.5)	0(0.0)	0(0.0)
921	*Collomia tenella*	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
#54	*Cryptantha* spp.	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
904	*Epilobium paniculatum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
886	*Gnaphalium microcephalum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
908	*Montia perfoliata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	4(0.5)	0(0.0)	0(0.0)
663	*Phacelia hastata*	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
996	Moss	8(0.5)	0(0.0)	1(0.5)	0(0.0)	3(1.3)
998	Rock	5(1.8)	0(0.0)	1(0.5)	0(0.0)	1(0.5)
999	Bare soil	8(1.3)	10(3.0)	4(5.3)	0(0.0)	4(0.5)
Years since disturbance	- average:	19	16	52	—	55
	- range:	7 - 34	—	7 - 83	—	11 - 76

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

APPENDIX C-2: PALATABILITY RATINGS, CONSTANCY,[1] AND AVERAGE CANOPY COVER (PERCENT) OF HERBACEOUS SPECIES BY HERB LAYER TYPE IN THE ABGR/ACGL H.T., PHMA PHASE

HERB LAYER GROUP

Herb layer type

Number of stands

ADP No.	Palatability ratings[2]	Deer Summer	Deer Winter	Elk Summer	Elk Winter	Cattle Summer	Sheep Summer	Black Bear Spring	Black Bear Summer	Black Bear Fall
	Perennial graminoids									
303	*Bromus carinatus*	4	2	6	4	6	4	0	0	0
282	*Bromus inermis*	4	4	6	4	6	4	0	0	0
304	*Bromus vulgaris*	4	2	4	4	6	4	0	0	0
307	*Calamagrostis rubescens*	2	4	6	4	6	4	6	4	2
309	*Carex geyeri*	4	4	6	6	6	4	6	4	2
284	*Carex microptera*	0	0	0	0	0	0	0	0	0
311	*Carex rossii*	2	2	4	2	2	4	6	4	2
318	*Festuca occidentalis*	4	4	4	6	6	6	0	0	0
	Ferns									
259	*Pteridium aquilinum*	4	0	2	0	2	4	0	0	0
	Perennial herbs									
401	*Achillea millefolium*	2	2	2	2	2	4	0	0	0
402	*Actaea rubra*	4	0	2	0	2	2	0	0	0
403	*Adenocaulon bicolor*	0	0	0	0	0	0	0	0	0
405	*Anaphalis margaritacea*	2	2	2	2	2	2	0	0	0
415	*Apocynum androsaemifolium*	2	0	2	0	2	2	0	0	0
420	*Arenaria macrophylla*	2	0	2	0	2	4	0	0	0
421	*Arnica cordifolia*	4	0	4	0	2	4	0	0	0
426	*Aster conspicuus*	2	2	4	2	4	4	0	0	0
429	*Astragalus canadensis*	2	0	4	0	2	4	0	0	0
438	*Castilleja miniata*	2	0	2	0	2	2	0	0	0
442	*Chimaphila umbellata*	0	0	0	0	0	0	0	0	0
445	*Circaea alpina*	0	0	0	0	0	0	0	0	0
*14	*Cirsium arvense*	2	2	2	2	2	2	0	0	0
455	*Disporum trachycarpum*	0	0	0	0	0	0	6	4	2
459	*Epilobium angustifolium*	4	2	6	2	2	4	0	0	0
465	*Fragaria vesca*	4	4	2	4	2	4	2	6	2
466	*Fragaria virginiana*	4	4	2	4	2	4	2	6	2
618	*Galium asperrimum*	0	0	0	0	0	0	4	2	2
471	*Galium triflorum*	2	0	2	0	2	4	4	2	2
473	*Geranium viscosissimum*	4	2	6	2	2	4	0	0	0
483	*Hieracium albertinum*	4	2	4	2	6	6	0	0	0

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP

Herb layer type

Number of stands

ADP No.	Palatability ratings[2]	Deer Summer	Deer Winter	Elk Summer	Elk Winter	Cattle Summer	Sheep Summer	Black Bear Spring	Black Bear Summer	Black Bear Fall
	Perennial herbs									
484	*Hieracium albiflorum*	4	2	4	2	6	6	0	0	0
833	*Iliamna rivularis*	4	0	6	0	4	6	0	0	0
636	*Lathyrus nevadensis*	4	2	4	2	6	6	0	0	0
505	*Osmorhiza chilensis*	2	0	2	0	2	4	6	4	2
509	*Pedicularis racemosa*	4	0	4	0	2	2	0	0	0
514	*Penstemon wilcoxii*	4	2	2	2	2	4	0	0	0
519	*Polemonium pulcherrimum*	4	0	4	0	2	4	0	0	0
522	*Potentilla glandulosa*	4	2	4	2	2	4	0	0	0
675	*Rudbeckia occidentalis*	4	2	2	2	2	4	0	0	0
542	*Smilacina racemosa*	6	2	4	2	2	4	6	4	2
543	*Smilacina stellata*	4	2	4	2	2	4	6	4	2
547	*Thalictrum occidentale*	4	2	6	2	2	4	0	0	0
562	*Thermopsis montana*	2	2	2	2	2	2	6	2	2
551	*Valeriana sitchensis*	4	0	6	0	2	4	0	0	0
691	*Veratrum californicum*	4	2	4	2	4	4	2	2	2
	Annuals, biennials, and short-lived perennials									
*12	*Cirsium vulgare*	2	2	2	2	2	2	0	0	0
902	*Collinsia parviflora*	2	0	2	0	2	2	0	0	0
921	*Collomia tenella*	2	0	2	0	2	2	0	0	0
#54	*Cryptantha* spp.	0	0	0	0	0	2	0	0	0
914	*Cryptantha affinis*	0	0	0	0	0	2	0	0	0
904	*Epilobium paniculatum*	2	0	2	0	2	2	0	0	0
930	*Gayophytum decipiens*	2	0	2	0	2	2	0	0	0
886	*Gnaphalium microcephalum*	2	0	2	0	2	4	0	0	0
874	*Gnaphalium viscosum*	2	0	2	0	2	4	0	0	0
908	*Montia perfoliata*	2	0	2	0	2	2	0	0	0
918	*Nemophila parviflora*	2	0	2	0	2	2	0	0	0
663	*Phacelia hastata*	4	2	4	2	2	4	0	0	0
911	*Polygonum douglasii*	2	0	2	0	2	2	0	0	0
*16	*Verbascum thapsus*	2	2	2	2	2	2	0	0	0
996	Moss									
998	Rock									
999	Bare soil									
	Years since disturbance - average:									
	- range:									

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

[2]Palatability ratings are taken from Kufeld and others (1973), Kufeld (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Annuals	*Bromus carinatus*		*Potentilla glandulosa*				*Epilobium angustifolium*	
Herb layer type		ANN. -ARCO	BRCA -BRCA	BRCA -FRVE	POGL -POGL	POGL -EPAN	POGL -PTAQ	POGL -FRVE	EPAN -FRVE	EPAN -THOC
Number of stands		*n* = 1	*n* = 1	*n* = 1	*n* = 5	*n* = 1	*n* = 1	*n* = 2	*n* = 1	*n* = 1
ADP No.	**Perennial graminoids**									
303	*Bromus carinatus*	0(0.0)	0(0.0)	10(15.0)	6(1.3)	0(0.0)	10(3.0)	10(0.5)	0(0.0)	10(0.5)
282	*Bromus inermis*	0(0.0)	10(15.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	0(0.0)	0(0.0)	0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
307	*Calamagrostis rubescens*	10(15.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	10(3.0)	10(0.5)
309	*Carex geyeri*	0(0.0)	10(0.5)	10(0.5)	0(0.0)	10(3.0)	0(0.0)	10(7.8)	0(0.0)	10(0.5)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	6(0.5)	10(3.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
311	*Carex rossii*	10(0.5)	0(0.0)	10(3.0)	8(0.5)	10(3.0)	10(0.5)	10(15.0)	10(3.0)	0(0.0)
318	*Festuca occidentalis*	0(0.0)	0(0.0)	10(15.0)	2(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
	Ferns									
259	*Pteridium aquilinum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(37.5)	0(0.0)	0(0.0)	0(0.0)
	Perennial herbs									
401	*Achillea millefolium*	0(0.0)	0(0.0)	10(0.5)	10(0.5)	10(0.5)	10(0.5)	10(0.5)	10(0.5)	0(0.0)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
403	*Adenocaulon bicolor*	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
405	*Anaphalis margaritacea*	0(0.0)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)
420	*Arenaria macrophylla*	0(0.0)	10(0.5)	10(0.5)	6(0.5)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)
421	*Arnica cordifolia*	10(0.5)	10(0.5)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	10(0.5)	10(0.5)	0(0.0)
426	*Aster conspicuus*	10(0.5)	10(0.5)	10(0.5)	6(1.3)	10(3.0)	10(3.0)	5(0.5)	10(3.0)	0(0.0)
429	*Astragalus canadensis*	0(0.0)	0(0.0)	0(0.0)	2(37.5)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
438	*Castilleja miniata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	10(0.5)	0(0.0)	10(3.0)	0(0.0)
442	*Chimaphila umbellata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)
445	*Circaea alpina*	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*14	*Cirsium arvense*	0(0.0)	0(0.0)	10(0.5)	2(0.5)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
459	*Epilobium angustifolium*	0(0.0)	10(0.5)	0(0.0)	6(0.5)	10(37.5)	10(0.5)	5(0.5)	10(15.0)	10(15.0)
465	*Fragaria vesca*	0(0.0)	10(0.5)	10(0.5)	8(0.5)	10(15.0)	0(0.0)	10(15.0)	10(15.0)	0(0.0)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
471	*Galium triflorum*	0(0.0)	0(0.0)	10(3.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
473	*Geranium viscosissimum*	0(0.0)	0(0.0)	0(0.0)	4(1.8)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	10(0.5)
483	*Hieracium albertinum*	10(0.5)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 -100%

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Annuals	*Bromus carinatus*		*Potentilla glandulosa*				*Epilobium angustifolium*	
Herb layer group		ANN. -ARCO	BRCA -BRCA	BRCA -FRVE	POGL -POGL	POGL -EPAN	POGL -PTAQ	POGL -FRVE	EPAN -FRVE	EPAN -THOC
Number of stands		*n* = 1	*n* = 1	*n* = 1	*n* = 5	*n* = 1	*n* = 1	*n* = 2	*n* = 1	*n* = 1
ADP No.	**Perennial herbs**									
484	*Hieracium albiflorum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
833	*Iliamna rivularis*	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	0(0.0)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
505	*Osmorhiza chilensis*	10(0.5)	0(0.0)	10(0.5)	4(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
509	*Pedicularis racemosa*	0(0.0)	0(0.0)	C(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
514	*Penstemon wilcoxii*	10(15.0)	0(0.0)	10(0.5)	8(1.1)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)
519	*Polemonium pulcherrimum*	0(0.0)	0(0.0)	0(0.0)	8(0.5)	0(0.0)	0(0.0)	5(15.0)	0(0.0)	0(0.0)
522	*Potentilla glandulosa*	10(0.5)	0(0.0)	0(0.0)	10(21.1)	10(15.0)	10(15.0)	10(1.8)	10(0.5)	0(0.0)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	8(1.1)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
542	*Smilacina racemosa*	0(0.0)	10(0.5)	10(0.5)	8(0.5)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	10(0.5)
543	*Smilacina stellata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
547	*Thalictrum occidentale*	0(0.0)	10(3.0)	10(0.5)	6(0.5)	10(0.5)	0(0.0)	5(3.0)	10(0.5)	10(62.5)
562	*Thermopsis montana*	0(0.0)	0(0.0)	0(0.0)	8(1.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
551	*Valeriana sitchensis*	0(0.0)	10(0.5)	0(0.0)	6(1.3)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	4(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Annuals, biennials, and short-lived annuals									
*12	*Cirsium vulgare*	10(0.5)	0(0.0)	10(0.5)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
902	*Collinsia parviflora*	10(3.0)	0(0.0)	0(0.0)	4(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
921	*Collomia tenella*	10(0.5)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
#54	*Cryptantha* spp.	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	0(0.0)	0(0.0)	10(0.5)	2(3.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
904	*Epilobium paniculatum*	0(0.0)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	0(0.0)	0(0.0)	0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
886	*Gnaphalium microcephalum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
908	*Montia perfoliata*	10(15.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
663	*Phacelia hastata*	C(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	0(0.0)	10(0.5)	0(0.0)	10(1.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	10(0.5)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)
996	Moss	0(0.0)	10(0.5)	0(0.0)	2(0.5)	10(3.0)	0(0.0)	5(3.0)	10(3.0)	0(0.0)
998	Rock	0(0.0)	0(0.0)	10(0.5)	6(0.5)	10(0.5)	10(0.5)	10(0.5)	10(0.5)	10(0.5)
999	Bare soil	10(3.0)	10(15.0)	10(3.0)	8(9.0)	10(3.0)	10(0.5)	10(9.0)	10(15.0)	0(0.0)
Years since disturbance - average:		5	7	7	8	13	20	7	10	55
- range:		—	—	—	3 - 13	—	—	—	—	—

[1]Code to constancy values: + = 0 - 5%, 1 + 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Castilleja miniata			Pteridium aquilinum		Fragaria vesca			
Herb layer type		CAMI -CAMI	CAMI -FRVE	CAMI -ARCO	PTAQ -FRVE	PTAQ -THOC	FRVE -FRVE	FRVE -ASCO	FRVE -ARCO	FRVE -THOC
Number of stands		*n* = 1	*n* = 1	*n* = 2	*n* = 1	*n* = 1	*n* = 6	*n* = 1	*n* = 2	*n* = 1
ADP No.	**Perennial graminoids**									
303	*Bromus carinatus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	10(0.5)
282	*Bromus inermis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	10(3.0)	3(0.5)	0(0.0)	0(0.0)	0(0.0)
307	*Calamagrostis rubescens*	10(3.0)	10(3.0)	10(26.3)	0(0.0)	10(0.5)	3(0.5)	10(3.0)	5(15.0)	0(0.0)
309	*Carex geyeri*	0(0.0)	0(0.0)	5(0.5)	10(0.5)	10(0.5)	7(1.1)	0(0.0)	10(1.8)	10(0.5)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
311	*Carex rossii*	10(0.5)	10(0.5)	10(0.5)	10(3.0)	10(0.5)	10(1.3)	0(0.0)	5(3.0)	10(0.5)
318	*Festuca occidentalis*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	10(0.5)	7(1.1)	0(0.0)	5(3.0)	0(0.0)
	Ferns									
259	*Pteridium aquilinum*	0(0.0)	0(0.0)	0(0.0)	10(15.0)	10(15.0)	2(0.5)	0(0.0)	0(0.0)	10(3.0)
	Perennial herbs									
401	*Achillea millefolium*	0(0.0)	10(0.5)	5(0.5)	10(0.5)	0(0.0)	3(0.5)	0(0.0)	5(0.5)	10(0.5)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
403	*Adenocaulon bicolor*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
405	*Anaphalis margaritacea*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	10(0.5)	0(0.0)	0(0.0)	5(0.5)	10(0.5)
420	*Arenaria macrophylla*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	10(3.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
421	*Arnica cordifolia*	10(3.0)	10(0.5)	5(0.5)	0(0.0)	10(3.0)	3(7.8)	0(0.0)	10(7.8)	0(0.0)
426	*Aster conspicuus*	10(0.5)	10(0.5)	10(1.8)	0(0.0)	10(0.5)	5(1.3)	10(15.0)	5(0.5)	10(3.0)
429	*Astragalus canadensis*	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
438	*Castilleja miniata*	10(3.0)	10(15.0)	10(15.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	10(0.5)
442	*Chimaphila umbellata*	0(0.0)	10(0.5)	5(0.5)	0(0.0)	0(0.0)	2(0.5)	10(0.5)	5(0.5)	0(0.0)
445	*Circaea alpina*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*14	*Cirsium arvense*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
459	*Epilobium angustifolium*	0(0.0)	10(3.0)	5(0.5)	0(0.0)	0(0.0)	7(0.5)	10(0.5)	5(0.5)	10(3.0)
465	*Fragaria vesca*	10(0.5)	10(15.0)	5(3.0)	10(15.0)	10(3.0)	10(20.1)	10(15.0)	10(15.0)	10(15.0)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(6.2)	0(0.0)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
471	*Galium triflorum*	10(0.5)	0(0.0)	0(0.0)	10(0.5)	10(15.0)	3(0.5)	10(0.5)	5(0.5)	10(0.5)
473	*Geranium viscosissimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)	10(0.5)
483	*Hieracium albertinum*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Castilleja miniata			Pteridium aquilinum		Fragaria vesca			
Herb layer type		CAMI -CAMI	CAMI -FRVE	CAMI -ARCO	PTAQ -FRVE	PTAQ -THOC	FRVE -FRVE	FRVE -ASCO	FRVE -ARCO	FRVE -THOC
Number of stands		*n* = 1	*n* = 1	*n* = 2	*n* = 1	*n* = 1	*n* = 6	*n* = 1	*n* = 1	*n* = 1
ADP No.	**Perennial herbs**									
484	*Hieracium albiflorum*	0(0.0)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
833	*Iliamna rivularis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
505	*Osmorhiza chilensis*	0(0.0)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	0(0.0)	10(0.5)	10(0.5)	0(0.0)
509	*Pedicularis racemosa*	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)
514	*Penstemon wilcoxii*	0(0.0)	0(0.0)	5(0.5)	10(0.5)	0(0.0)	3(0.5)	0(0.0)	5(0.5)	0(0.0)
519	*Polemonium pulcherrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	5(37.5)	0(0.0)
522	*Potentilla glandulosa*	0(0.0)	10(0.5)	10(0.5)	0(0.0)	10(0.5)	7(1.1)	0(0.0)	10(0.5)	10(0.5)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)
542	*Smilacina racemosa*	0(0.0)	10(0.5)	0(0.0)	0(0.0)	10(0.5)	5(0.5)	0(0.0)	10(0.5)	0(0.0)
543	*Smilacina stellata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	5(0.5)	0(0.0)
547	*Thalictrum occidentale*	10(3.0)	10(3.0)	5(3.0)	0(0.0)	10(15.0)	5(2.2)	10(3.0)	5(3.0)	10(15.0)
562	*Thermopsis montana*	10(15.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)
551	*Valeriana sitchensis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
	Annuals, biennials, and short-lived annuals									
*12	*Cirsium vulgare*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	5(0.5)	10(0.5)
902	*Collinsia parviflora*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(0.5)	0(0.0)
921	*Collomia tenella*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
#54	*Cryptantha* spp.	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
904	*Epilobium paniculatum*	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
886	*Gnaphalium microcephalum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
908	*Montia perfoliata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
663	*Phacelia hastata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(3.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	0(0.0)	0(0.0)	5(0.5)	10(0.5)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)
996	Moss	0(0.0)	10(0.5)	5(15.0)	0(0.0)	0(0.0)	7(9.0)	0(0.0)	5(3.0)	0(0.0)
998	Rock	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	7(0.5)	0(0.0)	5(0.5)	10(0.5)
999	Bare soil	10(0.5)	10(0.5)	10(20.3)	0(0.0)	0(0.0)	10(12.8)	10(0.5)	10(7.8)	10(0.5)
Years since disturbance	- average:	22	20	10	18	80	12	48	14	17
	- range:	—	—	—	—	—	8 - 16	—	—	—

[1]Code to constancy values: + = 0 - 5%; 1 = 5 - 15%; 2 = 15 - 25%; 3 = 25 - 35%; 4 = 35 - 45%; 5 = 45 - 55%; 6 = 55 - 65%; 7 = 65 - 75%; 8 = 75 - 85%; 9 = 85 - 95%; 10 = 95 - 100%

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Aster conspicuus			Arnica cordifolia		Thalictrum occidentale
Herb layer type		ASCO	ASCO	ASCO	ARCO	ARCO	THOC
Number of stands		n = 4	n = 2	n = 2	n = 12	n = 1	n = 4
ADP No.	**Perennial graminoids**						
303	*Bromus carinatus*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
282	*Bromus inermis*	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
304	*Bromus vulgaris*	5(1.8)	0(0.0)	5(0.5)	1(3.0)	0(0.0)	0(0.0)
307	*Calamagrostis rubescens*	5(1.8)	5(37.5)	5(15.0)	9(19.8)	10(3.0)	5(1.8)
309	*Carex geyeri*	5(15.0)	10(7.8)	0(0.0)	4(1.5)	0(0.0)	3(0.5)
284	*Carex microptera*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
311	*Carex rossii*	8(1.3)	0(0.0)	5(0.5)	4(0.5)	10(0.5)	0(0.0)
318	*Festuca occidentalis*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	10(0.5)	0(0.0)
	Ferns						
259	*Pteridium aquilinum*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
	Perennial herbs						
401	*Achillea millefolium*	5(0.5)	10(0.5)	5(0.5)	3(0.5)	10(0.5)	3(0.5)
402	*Actaea rubra*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
403	*Adenocaulon bicolor*	5(1.8)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	3(15.0)
405	*Anaphalis margaritacea*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
415	*Apocynum androsaemifolium*	0(0.0)	0(0.0)	5(0.5)	3(0.5)	0(0.0)	5(0.5)
420	*Arenaria macrophylla*	5(0.5)	5(0.5)	5(0.5)	6(0.9)	10(0.5)	5(1.8)
421	*Arnica cordifolia*	3(3.0)	5(15.0)	5(15.0)	10(10.5)	10(15.0)	10(1.8)
426	*Aster conspicuus*	8(10.2)	10(7.8)	10(15.0)	8(1.6)	0(0.0)	5(0.5)
429	*Astragalus canadensis*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.5)
438	*Castilleja miniata*	0(0.0)	5(3.0)	5(0.5)	3(1.8)	0(0.0)	3(0.5)
442	*Chimaphila umbellata*	3(3.0)	0(0.0)	0(0.0)	6(2.9)	10(0.5)	8(0.5)
445	*Circaea alpina*	3(0.5)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	3(3.0)
*14	*Cirsium arvense*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
455	*Disporum trachycarpum*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	10(0.5)	5(0.5)
459	*Epilobium angustifolium*	5(1.8)	10(0.5)	10(1.8)	2(0.5)	0(0.0)	5(3.0)
465	*Fragaria vesca*	8(0.5)	10(1.8)	10(1.8)	8(1.0)	10(0.5)	5(1.8)
466	*Fragaria virginiana*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
618	*Galium asperrimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
471	*Galium triflorum*	3(0.5)	0(0.0)	0(0.0)	4(1.0)	10(0.5)	8(1.3)
473	*Geranium viscosissimum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
483	*Hieracium albertinum*	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	0(0.0)

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

(con.)

APPENDIX C-2 (Con.)[1]

HERB LAYER GROUP		Aster conspicuus			Arnica cordifolia		Thalictrum occidentale
Herb layer type		ASCO -ASCO	ASCO -ARCO	ASCO -THOC	ARCO -ARCO	ARCO -THOC	THOC -THOC
Number of stands		*n* = 4	*n* = 2	*n* = 2	*n* = 12	*n* = 1	*n* = 4
ADP No.	**Perennial herbs**						
484	*Hieracium albiflorum*	5(1.8)	0(0.0)	5(0.5)	5(0.9)	0(0.0)	3(0.5)
833	*Iliamna rivularis*	0(0.0)	5(0.5)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
636	*Lathyrus nevadensis*	3(0.5)	0(0.0)	0(0.0)	2(0.5)	10(15.0)	0(0.0)
505	*Osmorhiza chilensis*	5(1.8)	0(0.0)	5(0.5)	2(3.0)	0(0.0)	5(0.5)
509	*Pedicularis racemosa*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
514	*Penstemon wilcoxii*	5(0.5)	5(0.5)	5(0.5)	5(0.9)	10(0.5)	0(0.0)
519	*Polemonium pulcherrimum*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
522	*Potentilla glandulosa*	5(0.5)	0(0.0)	0(0.0)	3(0.5)	0(0.0)	0(0.0)
675	*Rudbeckia occidentalis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
542	*Smilacina racemosa*	10(0.5)	0(0.0)	5(0.5)	6(0.5)	10(0.5)	8(0.5)
543	*Smilacina stellata*	0(0.0)	0(0.0)	5(0.5)	1(0.5)	0(0.0)	0(0.0)
547	*Thalictrum occidentale*	5(1.8)	10(7.8)	10(26.3)	5(4.6)	10(3.0)	10(12.0)
562	*Thermopsis montana*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)
551	*Valeriana sitchensis*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	3(0.5)
691	*Veratrum californicum*	0(0.0)	0(0.0)	0(0.0)	2(0.5)	0(0.0)	3(0.5)
	Annuals, biennials, and short-lived annuals						
*12	*Cirsium vulgare*	3(0.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
902	*Collinsia parviflora*	3(0.5)	0(0.0)	0(0.0)	3(0.5)	10(0.5)	0(0.0)
921	*Collomia tenella*	0(0.0)	0(0.0)	0(0.0)	1(0.5)	0(0.0)	0(0.0)
#54	*Cryptantha* spp.	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
914	*Cryptantha affinis*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
904	*Epilobium paniculatum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
930	*Gayophytum decipiens*	0(0.0)	0(0.0)	5(0.5)	0(0.0)	0(0.0)	0(0.0)
886	*Gnaphalium microcephalum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
874	*Gnaphalium viscosum*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
908	*Montia perfoliata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
918	*Nemophila parviflora*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(0.5)	0(0.0)
663	*Phacelia hastata*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
911	*Polygonum douglasii*	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
*16	*Verbascum thapsus*	3(0.5)	0(0.0)	5(0.5)	0(0.0)	10(0.5)	0(0.0)
996	Moss	3(0.5)	10(9.0)	0(0.0)	0(0.0)	10(0.5)	3(0.5)
998	Rock	3(0.5)	5(0.5)	0(0.0)	2(0.5)	0(0.0)	0(0.0)
999	Bare soil	10(1.1)	5(0.5)	10(1.8)	3(6.0)	10(3.0)	5(0.5)
Years since disturbance	- average:	36	34	18	49	49	68
	- range:	9 - 70	—	—	12 - 110	—	55 - 100

[1]Code to constancy values: + = 0 - 5%, 1 = 5 - 15%, 2 = 15 - 25%, 3 = 25 - 35%, 4 = 35 - 45%, 5 = 45 - 55%, 6 = 55 - 65%, 7 = 65 - 75%, 8 = 75 - 85%, 9 = 85 - 95%, 10 = 95 - 100%

APPENDIX D: SUCCESSION AND MANAGEMENT FIELD FORM FOR THE GRAND FIR/MOUNTAIN MAPLE H.T.

Name: ______________________ Location: ______________________

Date: __________ Elevation: __________ Aspect: __________ Slope(%): __________

Plot No.: __________

Topography (circle):

Ridge — Mid slope
Upper slope — Bench or flat
Lower slope — Stream bottom

Configuration (circle):

Concave (dry) — Convex (wet)
Straight — Undulating

Canopy Cover Classes:

0 - None	1 - 1 to 5%	3 - 25 to 50%	5 - 75 to 95%
T- Trace to 1%	2 - 5 to 25%	4 - 50 to 75%	6 - 95 to 100%

CANOPY COVERS

TREES

ADP	Rate coverage by dbh classes:	O.G. >18"	M. 18-12"	P. 12-4"	S. 4-.1"
001	*Abies grandis*				
002	*Abies lasiocarpa*				
006	*Larix occidentalis*				
007	*Picea engelmannii*				
010	*Pinus contorta*				
013	*Pinus ponderosa*				
014	*Populus tremuloides*				
016	*Pseudotsuga menziesii*				

SHRUBS

ADP		
102	*Acer glabrum*	
104	*Alnus sinuata*	
105	*Amelanchier alnifolia*	
198	*Ceanothus sanguineus*	
107	*Ceanothus velutinus*	
115	*Lonicera utahensis*	
122	*Physocarpus malvaceus*	
123	*Prunus emarginata*	
124	*Prunus virginiana*	
130	*Ribes lacustre*	
131	*Ribes viscosissimum*	
136	*Rubus parviflorus*	
137	*Salix scouleriana*	
142	*Spiraea betulifolia*	
143	*Symphoricarpos albus*	
163	*Symphoricarpos oreophilus*	
146	*Vaccinium globulare*	

GRAMINOIDS

ADP		
303	*Bromus carinatus*	
282	*Bromus inermis*	
307	*Calamagrostis rubescens*	
309	*Carex geyeri*	
284	*Carex microptera*	
311	*Carex rossii*	
318	*Festuca occidentalis*	

PERENNIAL HERBS AND FERNS

ADP		
403	*Adenocaulon bicolor*	
415	*Apocynum androsaemifolium*	
420	*Arenaria macrophylla*	
421	*Arnica cordifolia*	
426	*Aster conspicuus*	
429	*Astragalus canadensis*	
#15	*Castilleja* spp.	
459	*Epilobium angustifolium*	
465	*Fragaria vesca*	
466	*Fragaria virginiana*	
470	*Galium triflorum*	
833	*Iliamna rivularis*	
636	*Lathyrus nevadensis*	
519	*Polemonium pulcherrimum*	
522	*Potentilla glandulosa*	
259	*Pteridium aquilinum*	
547	*Thalictrum occidentale*	
562	*Thermopsis montana*	

ANNUALS, BIENNIALS, and SHORT-LIVED PERENNIALS

ADP		
412	*Cirsium vulgare*	
#56	*Collomia* spp.	
914	*Cryptantha* spp.	
904	*Epilobium* spp.	
886	*Gayophytum* spp.	
930	*Gnaphalium* spp.	
663	*Phacelia hastata*	
911	*Polygonum* spp.	
*16	*Verbascum thapsus*	

996	Moss	
998	Rock	
999	Bare Soil	

TREE LAYER TYPE	
SHRUB LAYER TYPE	
HERB LAYER TYPE	

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EXAMPLES OF SHRUB LAYER TYPES IN THE GRAND FIR/MOUNTAIN MAPLE H.T.

Published as part of—The Grand Fir/Mountain Maple Habitat Type in Central Idaho: Succession and Management—GTR-INT-284, 1992

ACGL-ACGL	*Acer glabrum*						
RUPA-RUPA	RUPA-ACGL	*Rubus parviflorus*					
SPBE-SPBE	SPBE-RUPA	SPBE-ACGL	*Spiraea betulifolia*				
ALSI-ALSI	ALSI-SPBE	ALSI-RUPA	ALSI-ACGL	*Alnus sinuata*			
SASC-SASC	SASC-ALSI	SASC-SPBE	SASC-RUPA	SASC-ACGL	*Salix scouleriana*		
RIVI-RIVI	RIVI-SASC	RIVI-ALSI	RIVI-SPBE	RIVI-RUPA	RIVI-ACGL	*Ribes viscosissimum*	
CEVE-CEVE	CEVE-RIVI	CEVE-SASC	CEVE-ALSI	CEVE-SPBE	CEVE-RUPA	CEVE-ACGL	*Ceanothus velutinus*

Successional classification diagram of the shrub layer in the ABGR/ACGL h.t.

Layer Groups

Acer glabrum

Acer glabrum - Acer glabrum

Fire scars suggest that this stand was underburned about 70 years ago. It has experienced no disturbance since then. No early seral species are evident on the site. All mid- to late-seral species are either poorly represented or absent. The climax species, *Acer* and *Physocarpus*, codominate the shrub layer.

Rubus parviflorus

Rubus parviflorus - Rubus parviflorus

A partial cut occurred here 9 years ago. Tractor skidding resulted in some scarification. The *Rubus* probably occurred here prior to the logging and simply increased as a result of the logging. Now it clearly dominates the shrub layer.

Rubus parviflorus - Acer glabrum

Clearcut and bulldozer-pile and burn operation occurred here 12 years ago. The scarification may have reduced the *Rubus* as it is now barely well represented. *Acer* and *Physocarpus* codominate the shrub layer. Both of these species largely survived the scarification.

Spiraea betulifolia

Spiraea betulifolia - Spiraea betulifolia

Site is transitional to an ABGR/SPBE habitat type. It was clearcut with no site treatment 16 years ago. The residual shrubs increased due to the full sunlight. *Spiraea* and *Symphoricarpos oreophilus* have developed high coverages. No other shrub species has a greater cover than *Spiraea*.

Spiraea batulifolia - Rubus parviflorus

Fire scars nearby suggest that this site experienced frequent underburns, with the last burn occurring about 50 years ago. *Spiraea* is barely well represented and *Rubus* dominates the shrub layer. Both of these species likely survived the burning and increased as a result of it.

Spiraea batulifolia - Acer globrum

Area was clearcut and thoroughly scarified 22 years ago. *Ribes* may have been well represented at one time but is now in a declining condition beneath the taller shrubs. *Spiraea* and *Acer* survived the scarification and now codominate the site.

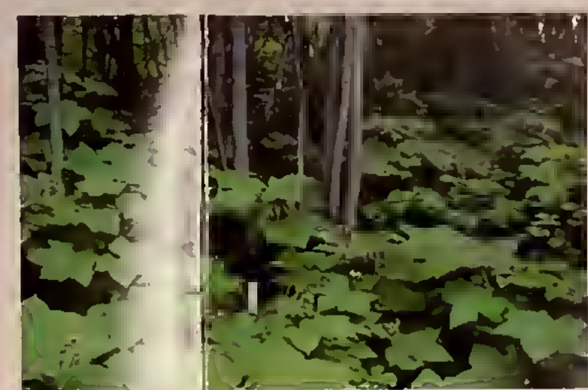
Salix scouleriana

Salix scoulariana - Salix scouleriana

A wildfire severely burned this area and created an ideal seedbed for *Salix*. The dense shrub layer has shaded and reduced less-tolerant species such as *Ceanothus*. *Physocarpus* is well represented but *Salix* is the dominant shrub.

Salix scouleriana - Spiraea betulifolia

Area was clearcut about 17 years ago. A broadcast burn was attempted but was not effective. The residual shrubs, mainly *Salix* and *Spiraea*, have increased their canopies due to the full sunlight. *Acer* is also well represented but *Spiraea* has the greatest canopy cover.



Salix scouleriana - Rubus parviflorus

Wildfire severely burned this area 31 years ago. *Salix* and *Rubus* codominate the site and form a dense shrub layer. One or both shrub species either established as a result of the fire or merely survived it. In either case their coverages increased with the increased sunlight.

Salix scoulariana - Acer glabrum

Area experienced a clearcut with no site preparation 16 years ago. The residual shrub species responded to the increased sunlight by increasing their canopy cover. Now *Salix* and *Prunus emarginata* are well represented, but *Acer* has the greatest cover.

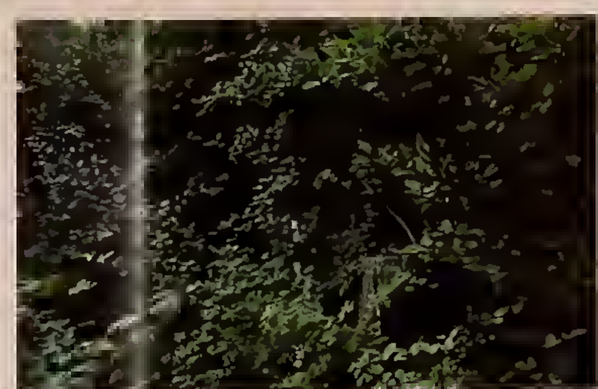
Ribes viscosissimum

Ribas viscosissimum - Ribes viscosissimum

Clearcut and bulldozer-pile and burn operation took place here 10 years ago. The area was thoroughly scarified, which caused many *Ribes* to germinate from buried seed. The *Ribes* now dominates the site.

Ribes viscosissimum - Salix scouleriana

RIVI-SASC layer type resulted from a seed-tree cut and thorough scarification 7 years ago. The *Ribes* germinated from buried seed and the *Salix* from wind-borne seed on the newly exposed soil. They now codominate the site. No other shrubs are well represented.



Ribes viscosissimum - Alnus sinuata

Thoroughly scarified clearcut existed here 11 years ago. *Ribes lacustre* germinated from buried seed as a result of the scarification. The *Alnus* resprouted from residual plants that were top-killed and also germinated from wind-borne seed on the exposed soil. *Alnus* now dominates the shrub layer.

Ribes viscosissimum - Spiraea betulifolia

Area logged and scarified 8 years ago. *Ribes* germinated from buried seed. *Spiraea* survived the disturbance and has increased by rhizomes. The two shrub species now codominate the site. *Physocarpus* is the only other shrub that is well represented.

Ribes viscosissimum - Acar glabrum

RIVI-ACGL layer type resulted from a clearcut and partial scarification. Enough *Ribes* germinated due to the scarification to become well represented. The *Acer* survived the disturbance and is increasing its canopy cover in response to full sunlight. No other shrubs are well represented.

Ceanothus velutinus

Ceanothus velutinus - Ceanothus velutinus

Clearcut and broadcast burned 13 years ago. *Pinus ponderosa* seedlings were planted the following spring. *Ceanothus* germinated from buried seed in response to the burn and now dominates the site.

Ceanothus velutinus - Ribes viscosissimum

CEVE-RIVI layer type resulted from a well-scarified *Pinus ponderosa* seed tree cut. *Ceanothus* from buried seed is barely well represented. *Ribes*, also from buried seed, dominates the shrub layer.

Ceanothus velutinus - Salix scouleriana

Clearcut and wildfire occurred here 9 years ago. The area was contour stripped and planted to *Pinus ponderosa* 2 years later. *Ceanothus* is well represented due to the burn. *Salix* dominates the site as a result of resprouting after the burn and germination of wind-borne seed on soil exposed by burning and stripping.

Ceanothus velutinus - Spiraea betulifolia

Area clearcut and broadcast burned 7 years ago. *Ceanothus* germinated from buried seed as a result of the burn. *Spiraea* survived the burn and increased to become dominant shrub. No other shrub species are well represented.

Ceanothus velutinus - Rubus parviflorus

Clearcut and broadcast burned 12 years ago. *Ceanothus* germinated from buried seed in response to the burn. *Rubus* (partly obscured by the *Ceanothus* and absent in adjacent uncut stands) also germinated from buried seed and has increased by rhizomes. *Physocarpus* is also well represented, but the *Ceanothus* and *Rubus* codominate the site.

Ceanothus velutinus - Acer glabrum

Area was clearcut 20 years ago. Logging slash was burned as small piles, resulting in patches of *Ceanothus*. The *Acer* has increased in response to full sunlight. The two shrubs now codominate the site.

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Steele, Robert; Geier-Hayes, Kathleen. 1992. The grand fir/mountain maple habitat type in central Idaho: succession and management. Gen. Tech. Rep. INT-284. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 90 p.

Presents a taxonomic system for classifying plant succession in the grand/fir mountain maple habitat type in central Idaho. A total of 15 potential tree layer types, 34 shrub layer types, and 55 herbaceous layer types are categorized. Diagnostic keys based on indicator species provide for field identification of the types. Discussion of management implications includes pocket gopher populations, success of planted and natural tree seedlings, big-game and livestock forage preferences, and responses of major shrub and herb layer species to disturbance.

KEYWORDS: forest succession, plant communities, forest ecology, forest management, silviculture, classification, Idaho

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